# RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

Vol. 61 NOVEMBER, 1953 No. 5

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# Coarctation of the Aorta[1]

## The Roentgenologic Aspects of One Hundred and Twenty-Five Surgically Confirmed Cases

ROBERT D. SLOAN, M.D., and ROBERT N. COOLEY, M.D.

COARCTATION OF THE aorta is a congenital malformation in which a segment of the aorta is constricted. Classically, the narrowing occurs between the origin of the left subclavian artery and just distal to the site of insertion of the ductus or ligamentum arteriosum, involving only a relatively short segment of the aorta (1). While there may be any degree of narrowing of the aortic lumen at the site of the coarctation, there is usually a marked stenosis, or less frequently an atresia, in the clinically significant cases. Rarely, coarctation occurs in other areas (2–8), either proximally in the aortic arch or in the distal thoracic or abdominal aorta, and in some instances the involved segment may be of considerable length.

Coarctation in individual cases carries a variable prognosis, but it has been clearly established that the overall life expectancy of a group of patients with coarctation is much shorter than that of the population at large (1, 9). Frequently, coarctation occurs in association with other serious cardiovascular malformations, and in such cases the life expectancy is generally quite short. In 13,000 consecutive autopsies at The Johns Hopkins Hospital, coarctation was noted in 24 instances, or roughly once per 500 autopsies. Twenty-one of these 24 coarctations were in stillborn or young infants, and almost invariably other significant cardiovascular anomalies were present. Of more clinical importance, although statistically less frequent, are cases in which the coarctation is either the only cardiovascular anomaly, or other anomalies, if present, are of a relatively minor nature. Here the life expectancy is greater, but still below that of the general population. The increased mortality in this group may be due to several causes. Classically there is hypertension proximal to the site of coarctation, with relative hypotension distally. Hence, the more common causes of death are cardiac failure and the other complications associated with hypertension. In a significant number of these patients a dissecting aneurysm may develop or rupture of the aorta may ensue. This usually occurs in the ascending aorta and rarely in the post-stenotic segment or adjacent intercostal arteries. Bacterial endocarditis and endarteritis, frequently superimposed upon an anomalous bicuspid aortic valve or the coarctation site, also occur in these patients, and an increased incidence of congenital intracranial aneurysms has been observed.

Prior to 1945, coarctation was a clinical curiosity of academic interest only. In

[1] From the Department of Radiology, The Johns Hopkins Hospital and University, Baltimore, Md. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

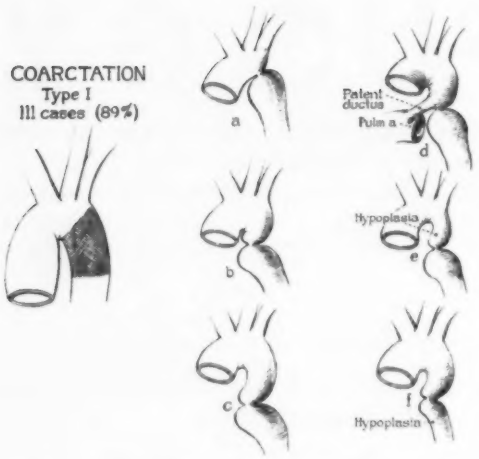



Fig. 1. The most common type of coarctation. The constriction is located somewhere between the origin of the left subclavian artery and the region of the ligamentum or ductus arteriosus, and its length and nature are such as to permit its excision and the establishment of an adequate aortic lumen by an end-to-end anastomosis. Several of the anatomical variations which are of no real significance from a practical surgical standpoint are included.

that year, Crafoord and Nylin (10) and Gross (11) independently reported successful resections of coarctations with reestablishment of the continuity of the aortic lumen. Since that time surgery has been performed on many cases of coarctation and the practicality and effectiveness of this method of treatment have been clearly demonstrated. The result is that in medical centers where vascular surgery of this type is being performed, coarctation is no longer either rare or of only academic interest. Along with the general increase in clinical interest in the anomaly, there has been an awakened interest in its radiological aspects.

In the present paper, based upon experience with 125 surgically confirmed coarctations of the aorta seen at The Johns Hopkins Hospital, emphasis will be placed upon the radiologic findings. This group does not include the total operative experience with the anomaly, several cases not being included because either the radiographic studies or the unit histories were not available for examination. Nor does it include those clinically obvious coarctations which for various reasons have not been subjected to surgery.

## GENERAL FINDINGS

The age distribution of the 125 surgically confirmed coarctations, at the time of surgery, is as follows:

| Age in Years | No. Cases |
|---|---|
| 0–5 | 6 |
| 6–10 | 15 |
| 11–20 | 46 |
| 21–30 | 40 |
| 31–40 | 17 |
| 41– | 1 |
| TOTAL | 125 |

The youngest patient in the series was ten weeks of age, the oldest forty-one years. It will be seen that the majority of patients were operated upon in the second and third decades of life, and it is generally accepted that operation in older groups carries with it a greater risk and less chance of a good therapeutic result.

There were 88 males and 37 females in the series, a ratio slightly greater than 2 to 1 in favor of the males. This same preference for the male has been noted in other large series of coarctations (1, 9). Only one patient in the group was of the Negro race.

There is, at the present time, no completely satisfactory or universally accepted classification of coarctation. Bonnet's division into infantile and adult types (12), accepted for so many years, has little practical clinical application. In analyzing our cases and reviewing the literature, it seemed that the great majority of clinically significant coarctations could be divided into three general types, based upon the practical anatomical aspects of the anomaly in relation to its surgical treatment.

*Type I:* The coarctation is located in the usual site, somewhere between the origin of the left subclavian artery and the region of the ligamentum or ductus arteriosus, and its length and nature are such as to permit its excision and the establishment of an adequate aortic lumen by an end-to-end

anastomosis (Fig. 1). Of the coarctations in our series, 111, or 89 per cent, were of this type.

In this group there are several anatomical variations which are of no real significance from a practical surgical standpoint. For example, there may be considerable variation in the length of the proximal aortic segment from the origin of the left subclavian artery to the site of coarctation (Fig. 1 *a*, *b*, and *c*), but a skilled and experienced surgeon will be able to cope with such a variation. The presence of a patent ductus does not seriously complicate the surgical treatment, since in 7 patients of our series the ductus was definitely patent and in 5 others the surgeon was uncertain as to its status (Fig. 1 *d*). There are also cases in which there is a relative hypoplasia of the aorta proximal or distal to the coarctation (Fig. 1 *e* and *f*). While it has been suggested that the final therapeutic result in these cases may not be as satisfactory (13), the majority of surgeons still agree that one is justified in resecting the area of maximal narrowing.

An end-to-end anastomosis was performed in 110 of these patients. In the remaining case such an anastomosis would have been feasible but, before it could be undertaken, death occurred on the operating table.

*Type II:* The coarctation is located in the usual site, as in Type I, but its effective length and nature are such that, following excision, establishment of an adequate aortic lumen by an end-to-end anastomosis is not feasible (Fig. 2). Ten of our 125 cases, or 8 per cent, were of this type.

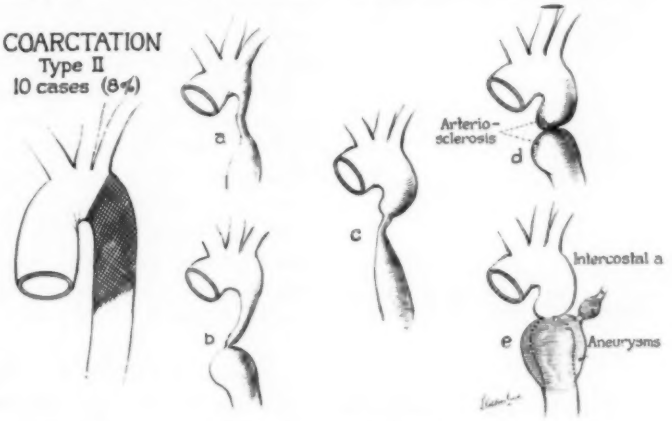



Fig. 2. The coarctation is located in the usual site, as in Type I, but its effective length and nature are such that following excision it is not feasible to establish an adequate aortic lumen by an end-to-end anastomosis. Included are several of the anatomical variants resulting in an increase in the effective length of the lesion.

Here also may be grouped several different anatomical variants. For example, the actual coarctation length may be greater than usual (Fig. 2 *a*) or the practical length of the coarctation may be increased by a relatively pronounced hypoplasia of the aorta just proximal or distal to the area of maximum constriction (Fig. 2 *b* and *c*). In some instances, arteriosclerotic changes in the aortic segments adjacent to the coarctation may necessitate the removal of a longer segment than usual, or inelasticity may prevent the approximation of the resected ends (Fig. 2 *d*) (14). Finally, cases have been reported in which aneurysms, mycotic or otherwise, adjacent to the coarctation site complicated surgical repair (Fig. 2 *e*) (14). The aortic intercostals in the segment just distal to the coarctation are frequently quite large and thin-walled, and in the current series actual aneurysms of these

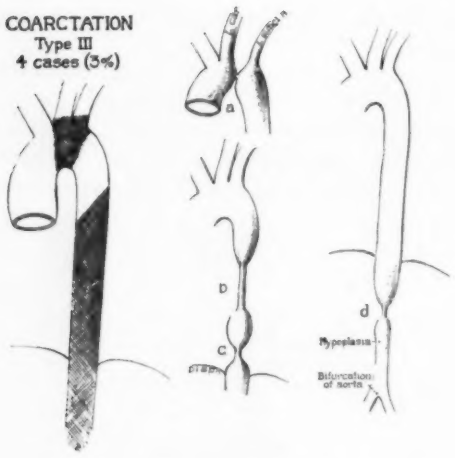



Fig. 3. The coarctation is not located at the usual site. It may occur proximally in the aortic arch, or distally in the descending thoracic or abdominal aorta.

vessels were encountered in 9 patients. While the presence of an intercostal aneurysm does not necessarily preclude the possibility of resection of the coarctation and end-to-end anastomosis, it occasionally does so.

In general, there are two surgical approaches to the repair of coarctations of Type II. The left subclavian artery may be swung down and anastomosed to the distal aortic segment, or preferably an aortic graft may be used to bridge the gap between the free ends of the aorta. Five patients in the current series had a subclavian-aortic anastomosis, and in 3 instances grafts were used. In 1 of the 2 remaining patients the anatomical arrangement was such that it was not practical to bring down the left subclavian for an anastomosis, and an aortic graft was not available at the time of surgery. In the final case, the patient died on the operating table prior to a planned subclavian-aortic anastomosis. Theoretically an aortic graft would have been feasible in both of these cases.

*Type III:* The coarctation is not located at the usual site. It may occur proximally in the aortic arch, sometimes involving the left subclavian or carotid artery, or it may be found distally in the descending thoracic or abdominal aorta (Fig. 3).

Four cases, or 3 per cent of the series, can be placed in this group. In 2 patients the coarctation involved or was proximal to the origin of the left subclavian artery, and in both instances successful resection and end-to-end anastomosis were undertaken. In 1 of the remaining cases there was a diffuse and fairly marked narrowing of the entire middle third of the descending thoracic aorta, and only a sympathectomy was performed. In the final patient there was a coarctation of the abdominal aorta just distal to the origins of the renal arteries. Below the area of maximal narrowing the aorta and iliac arteries were rather hypoplastic, and no definitive surgical therapy seemed feasible.

## RADIOLOGIC ASPECTS

In all of the 125 surgically confirmed coarctations, routine radiologic studies were available. These consisted of either standard chest films or barium-swallow studies in the postero-anterior and both oblique projections. In addition, contrast vascular studies were undertaken in 60 patients. A total of 47 angiocardiograms and 18 aortograms were obtained, 5 patients having both procedures. In 3 instances the contrast studies were done following surgical repair of the coarctation.

The radiologist has two basic responsibilities in cases of coarctation. The first is to suggest the diagnosis, provided that this has not already been done by non-radiologic means. An alert clinician can make an accurate diagnosis of coarctation by detecting the hypotension in the lower extremities in the presence of hypertension in the upper extremities, and by observing the pulsating collateral vessels in the chest wall. Associated precordial and interscapular murmurs are also frequently present in this condition. In the majority of the cases in the current series, the correct diagnosis had been made prior to the patient's arrival at our institution. In reviewing the histories, however, it was obvious that a sizable group had been

followed by physicians elsewhere for months or years before the presence of coarctation was detected, and in a considerable number of the cases it was a radiologist who first suggested the correct diagnosis. Once the diagnosis has been made, it is the radiologist's responsibility to evaluate the radiologic status of the heart and great vessels, the collateral circulation and, if possible, the site and anatomy of the coarctation itself.

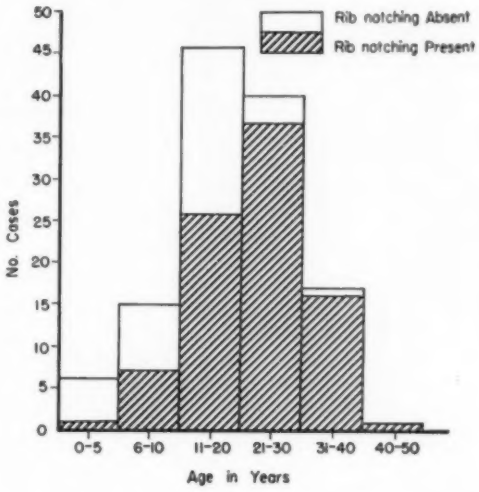
### *Routine Radiologic Studies*

Ordinarily contrast vascular studies are not performed until after the diagnosis has been made, and therefore the radiologist will have his first opportunity to suggest the correct diagnosis and evaluate the coarctation on the basis of routine chest films, fluoroscopy, and/or barium-swallow studies. In such examinations, the positive radiologic findings center not only around the coarctation itself but depend also on the demonstration of secondary changes produced by the obstruction. These various findings will be discussed in order of their practical importance.

*Rib Notching:* Rib notching still remains the single most important radiologic sign of coarctation. The significance of these notches along the costal grooves, as demonstrated radiologically, was reported by Roesler (15) in 1928 and independently by Railsback and Dock (16) the following year. A hundred years prior to this, however, the tortuous intercostal arteries, their significance as collateral channels, and the fact that they eroded ribs had been clearly noted in pathological and anatomical dissections (Fig. 4A) (17). At times these vessels may become so tortuous that they extend down to and actually erode the superior borders of adjacent ribs, and this superior notching has been noted on the films of 3 patients in the current series (Fig. 4B).

Classical rib notching was detected on the films of 88 patients, or 70 per cent of our 125 cases. The fourth through the eighth ribs were most commonly involved, the third and ninth ribs infrequently, and

TABLE I: RELATIONSHIP BETWEEN AGE AND DETECTABLE RIB NOTCHING IN 125 CASES OF COARCTATION




the second rib rarely. No notching was demonstrated in the first or last three ribs. It is well recognized that the incidence of detectable rib notching increases with age, and this was true in the current series. This relationship of age to detectable notching is set forth in Table I, where it will be noted that only above the age of twenty is rib notching found in the great majority of patients. Our youngest patient with definite rib notching was five years of age, and it is of interest that this was no longer obvious on films taken two years after surgical repair of the coarctation. Fairly extensive unilateral right-sided notching has been noted in cases where the origin of the left subclavian artery is involved in the coarctation (3, 7) and was present in the 2 patients in our series where such an anatomical situation existed.

Slight variations in exposure and projection may change to a surprising degree one's ability to identify a given notch on a rib. Also, in attempting to evaluate objectively the presence of notching, one should recall that there is no sharp dividing line between the normal irregularities seen along the costal groove and early notching. Nor does the absence of notch-

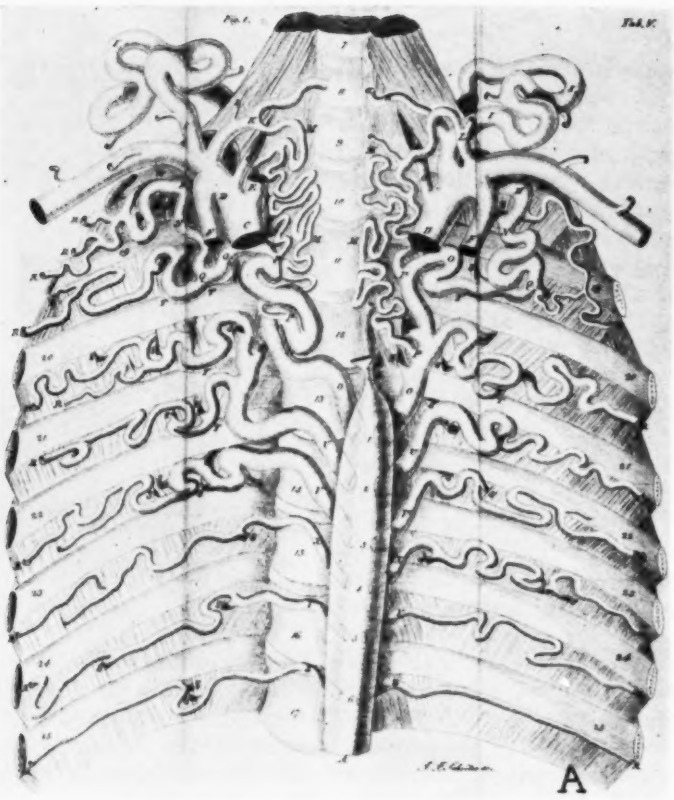



Fig. 4A. An illustration taken from Meckel's *Archives of Anatomy and Physiology* published in 1827. The tortuous intercostal arteries and their significance as collateral channels are well shown. Note that the artist depicted notching of the superior borders of several ribs.

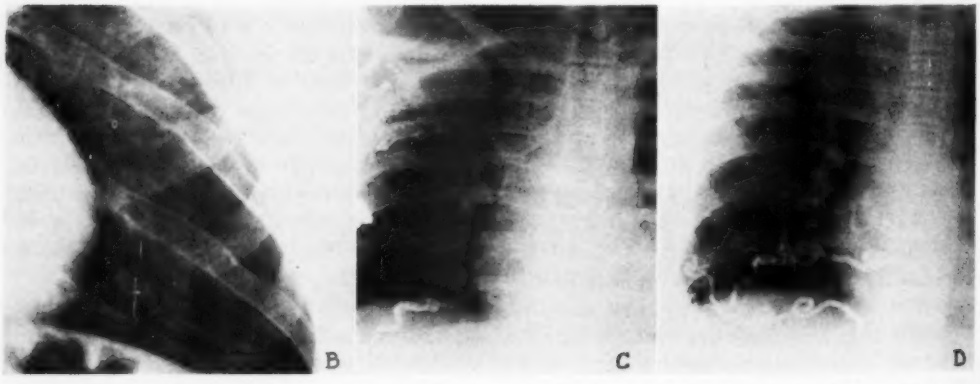



Fig. 4B, C, and D. Classically notching occurs along the inferior borders of the ribs, but rarely it may be found along the superior border. This superior notching was detected in three of our cases, the most pronounced of these being illustrated here (B).

The absence of notching does not mean that the intercostals are not entering into the collateral circulation pathways. Routine films in the case shown in C and D revealed no notching, but contrast medium introduced into the distal portion of the right subclavian artery clearly demonstrates dilated and tortuous intercostal collaterals. It is of interest that the lower intercostals are the most prominent (D), although the coarctation was of the typical type.

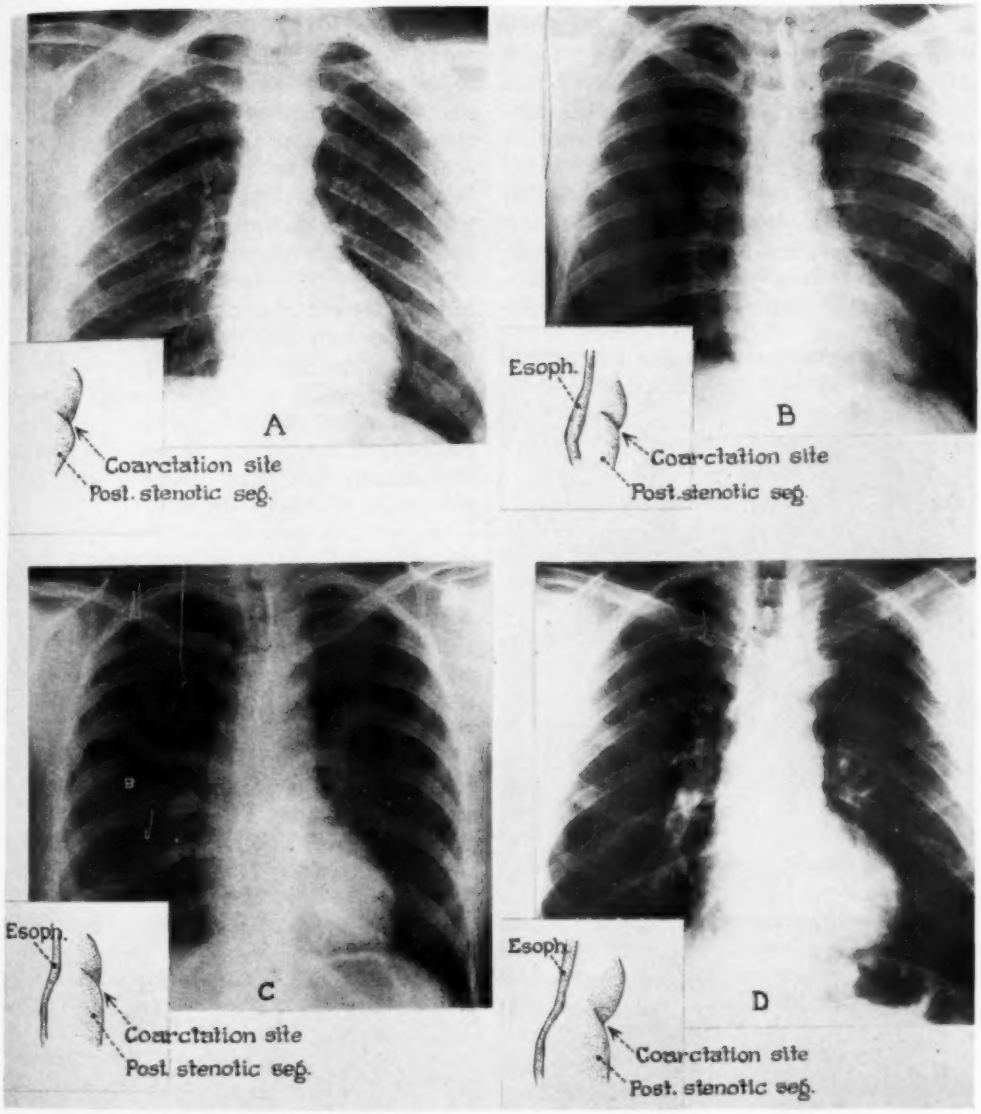



Fig. 5. Examples of the figure "3" sign, as seen in the postero-anterior projection. The indentation indicates the site of the coarctation. The distal portion of the curve delineates the poststenotic segment; the proximal or superior segment, either the left subclavian artery or the segment of aorta proximal to the coarctation.

ing mean that the intercostals are not entering into the collateral circulation pathways (Fig. 4C and D). It has been noted in the literature that rib notching is not specific for coarctation, but from a practical standpoint other causes are not of real significance (18–20).

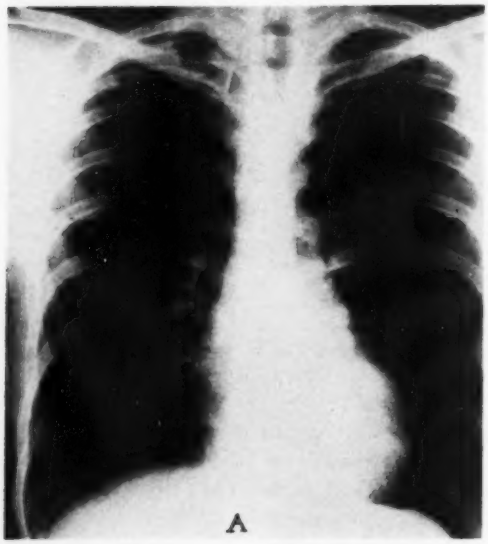
*Figure "3" Sign:* Fray (21), in 1930, noted a defect or break in the continuity of the distal aortic arch in the left oblique position in two cases of coarctation. In 1937 Wolke (22), in describing the radiologic aspects of coarctation, commented on a double aortic curve in the postero-anterior projection in the region of the coarctation, and an indentation seen in the

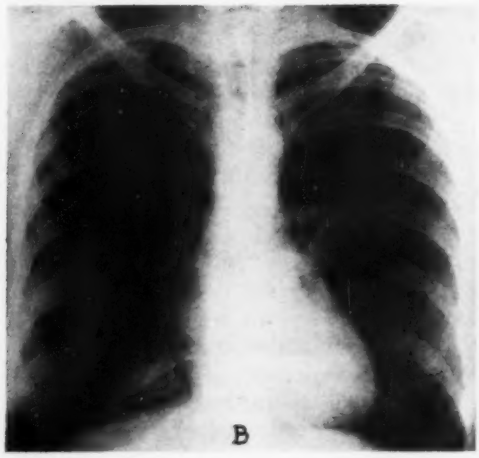
left anterior oblique projection in the same area. More recently, Bruwer and Pugh (23) have again called attention to this sign. Basically it consists in the postero-anterior projection of a tuck or indentation somewhat in the form of the numeral "3" along the left border of the mediastinum in the region of the distal aortic arch (Fig. 5). Surgical experience and contrast vascular studies have revealed that the indentation itself usually indicates the site of the coarctation. The distal portion of the curve delineates the post-stenotic segment of the aorta, while the proximal or superior segment may represent either the left subclavian artery in those cases where the coarctation is just distal to the origin of this artery, or the segment of aorta proximal to the coarctation when the anomaly occurs somewhat more distally.

The figure "3" sign was detected in 33 of the 125 cases of our series, or 26 per cent. It is suspected that this percentage would be somewhat increased if several films of differing density and degrees of obliquity were obtained on each patient. Laminagrams may be of aid in demonstrating the indentation, but our experience with this procedure has been limited.

Cases have been reported in the literature in which calcification has been demonstrated in the region of the coarctation. This may occur in the presence of extensive arteriosclerotic changes in either the proximal or distal segment, or in the walls of aneurysms in this region (24–26). In one patient we were able to demonstrate calcification in the walls of an intercostal aneurysm immediately adjacent to the post-stenotic segment.

*Contour of Aortic Knob:* Absence of the aortic knob in the postero-anterior projec-



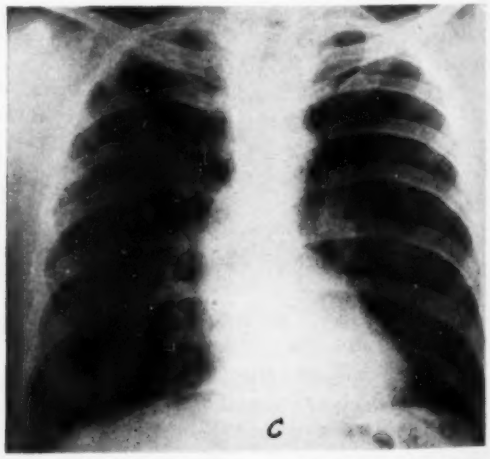




Fig. 6. Classically there is said to be an absence of the aortic knob in the postero-anterior projection. While on occasions this absence may be striking (A), one may also find in typical coarctations a rounded prominence that cannot be distinguished from a normal or slightly prominent aortic knob (B and C).

tion has often been mentioned as one of the signs of coarctation (Fig. 6A). In 73 cases of our series, or 58 per cent, there was no obvious aortic knob projecting from the left mediastinal border. While on occasions this absence has been rather striking, particularly in adults where the ascending aorta is abnormally prominent, in younger individuals the absence of the knob cannot be considered as being so remarkable. In 52 patients, or 42 per cent, there was a rounded prominence that one could not distinguish from a normal or slightly prominent aortic knob (Fig. 6B and C).

Several factors probably play a role in obscuring the aortic knob in coarctation. There may in some cases be a relative hypoplasia of the aortic arch. In most instances, however, the arch is actually at least of normal size. In the classical coarctation there is definite anterior and medial displacement of the aorta at the site of insertion of the ligamentum arteriosum, tending to draw the distal arch deeper into the mediastinum (27). Finally, the left subclavian artery may be abnormally prominent along the left upper mediastinal border, tending to obscure the contour of the knob (28).

*Esophageal Displacement by Post-stenotic Segment:* Fleischner, in 1949, demonstrated that the dilated post-stenotic segment may displace the esophagus to the right and anteriorly (29). There is no question that on occasions this displacement is so marked as to indicate clearly the site of the post-stenotic segment, but in many cases one has difficulty in objectively separating this from the usual esophageal displacement by the distal aortic arch.

*Cardiac Contour:* Proximal to a significant degree of coarctation hypertension is almost invariably present, there being only 3 patients in this series who did not have clinical evidence of such hypertension. Left ventricular enlargement, secondary to hypertension or occasionally to other cardiovascular malformations, is the most common abnormality detected in the cardiac contour in these cases. In 67 of our patients, or 54 per cent, there was definite and apparently selective prominence of the left ventricle. In 7 instances (5 per cent) generalized cardiac enlargement was found, and this tended to occur in relatively young children, some of whom had clinical evidence of other cardiovascular anomalies. The radiologic contour of the heart was not obviously abnormal in 51 patients, or 41 per cent of the series.

In general, there was nothing atypical about the cardiac contour in any of our cases which would by itself lead one to suspect the presence of coarctation.

*Contour of Ascending Aorta:* The ascending aorta was not abnormally prominent on routine radiographic studies in 85 cases, or 68 per cent of the series. This does not necessarily mean that in these cases there was not some degree of dilatation, since in several instances an ascending aorta which was thought to be normal on routine studies was revealed to be moderately dilated by contrast vascular studies. In 40 cases, or 32 per cent, there was obvious tortuosity or dilatation on the routine films, and in 3 cases this was so marked as to be aneurysmal in nature. It has been suggested in the literature that there may be a congenital weakness of the media in such cases (1), and that one cannot always correlate the degree of dilatation with the duration or severity of the hypertension or the width of the pulse pressure. Certainly at fluoroscopy the ascending aorta often exhibits unusually vigorous pulsations (Fig. 7).

### *Contrast Vascular Studies*

The chief radiologic interest in coarctation in recent years has centered around attempts at visualization by contrast vascular technics. Such studies have been performed with two main purposes in mind: (1) to confirm the clinical diagnosis of coarctation and (2) to demonstrate its anatomical pattern in an effort to aid in the surgical attack. Both angiocardiography and aortography have been utilized.

*Angiocardiography:* For all angiocardiographic procedures the basic technic popu-

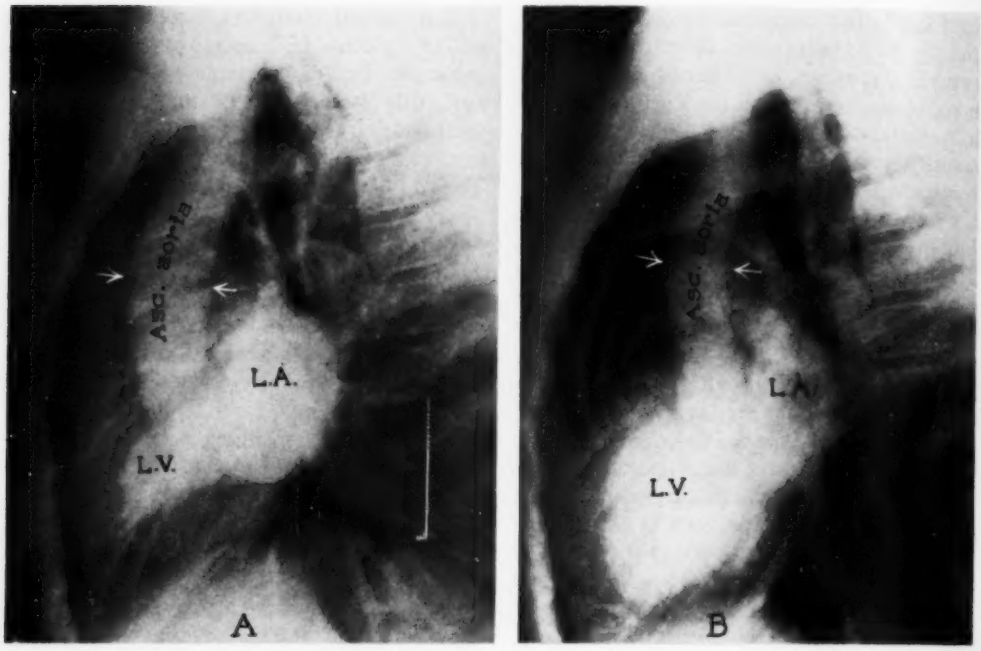



Fig. 7. At fluoroscopy the ascending aorta may exhibit unusually vigorous pulsations. In this angiocardiogram the variation in contour of the ascending aorta and aortic arch with systole (A) and diastole (B) is well shown.

larized by Robb and Steinberg (30) was employed. The contrast medium in every instance was 70 per cent Diodrast, although at the present time we are using 70 per cent Urokon. In our experience the true lateral has been the most satisfactory projection for visualizing the coarctation site, and therefore the oblique and anteroposterior projections have been used only rarely. If an ideal study of the coarctation is to be obtained, it is essential that the angiocardiographic equipment used permit the obtaining of serial films. We have found the arm-to-tongue circulation time with Decholin to be of aid in determining when to time the exposures. The rule of thumb which we have used has been to start the radiographic series at one-half of the Decholin arm-to-tongue circulation time, and to extend the series over the following seven to twelve seconds. Experience has shown that this usually covers the phase of maximum opacification of the aorta, both proximal and distal to the site of coarctation.

In all, 47 patients were subjected to angiocardiography. In 2 instances, this procedure was performed following surgical repair of the coarctation, and these will not be included in the current analysis. Seven of the 45 preoperative angiocardiograms were totally unsatisfactory for diagnostic purposes. Mechanical equipment failures and poor injections, with resultant inadequate opacification of the aorta, accounted for most of these unsatisfactory studies. In 24 instances the results were such that the diagnosis of coarctation could be confirmed, but the extent and exact anatomy of the coarctation were inadequately visualized for complete diagnostic purposes (Fig. 8). The usual finding in such cases was an adequate concentration of the contrast medium in the ascending aorta, with a gradually diminishing opacification of the arch, particularly in its distal portion, and in the aorta near the coarctation. On other occasions the aortic arch and the great vessels arising from it were adequately demonstrated, only

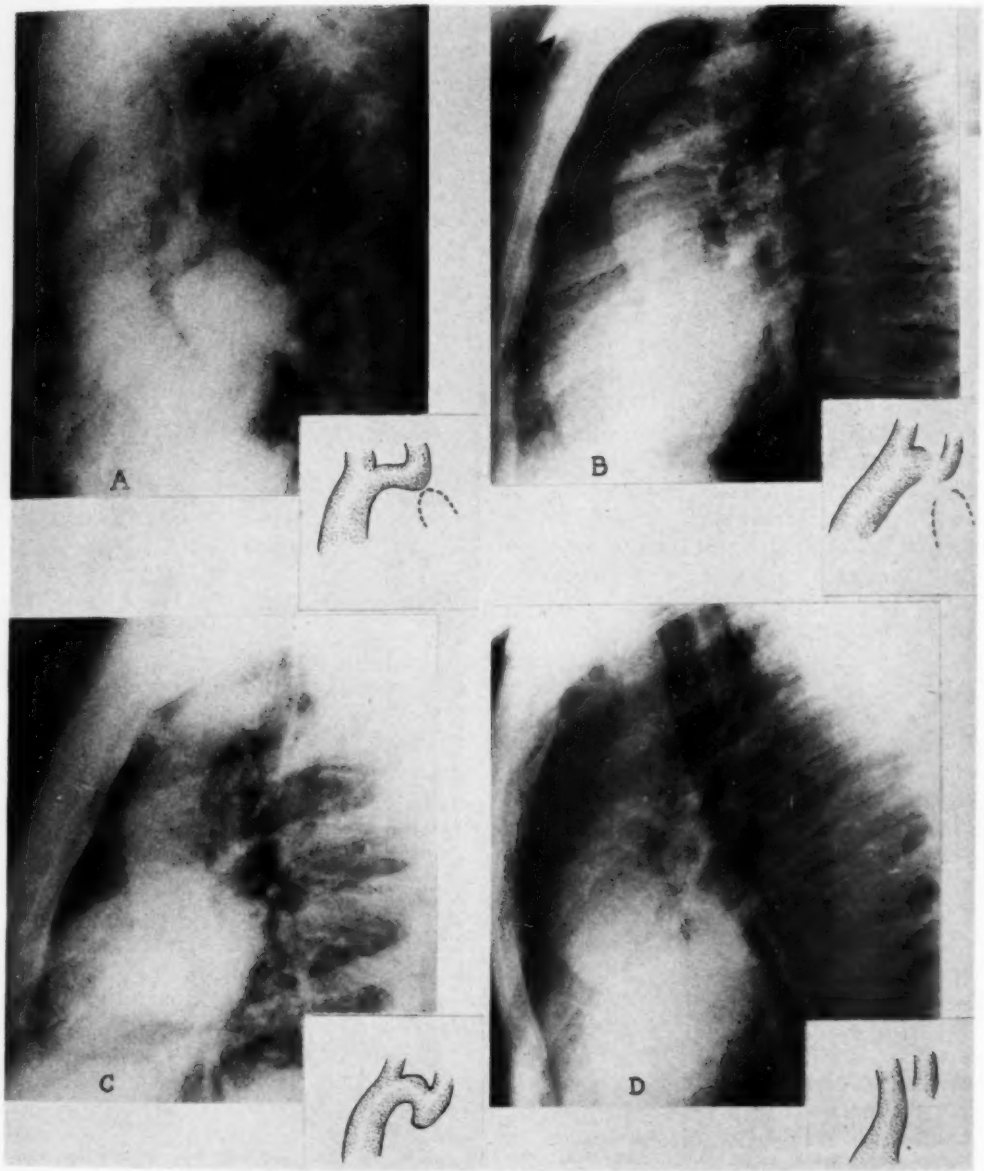



Fig. 8. Examples of angiocardiograms in which the diagnosis of coarctation can be confirmed, but the extent and exact anatomy of the coarctation are inadequately visualized for complete diagnostic purposes. Note the relatively good concentration of the opaque medium in the ascending aorta in each case.

to have the aortic segments proximal or distal to the actual coarctation incompletely visualized. While in these cases one can see enough to substantiate the clinical diagnosis, this is in itself of little practical value to the surgeon. In several instances we misinterpreted the radiologic appearance and suggested that the coarctation was of considerable length, only to have the surgeon find a typical, short and easily resectable lesion at thoracotomy.

In 14 instances not only was the diag-

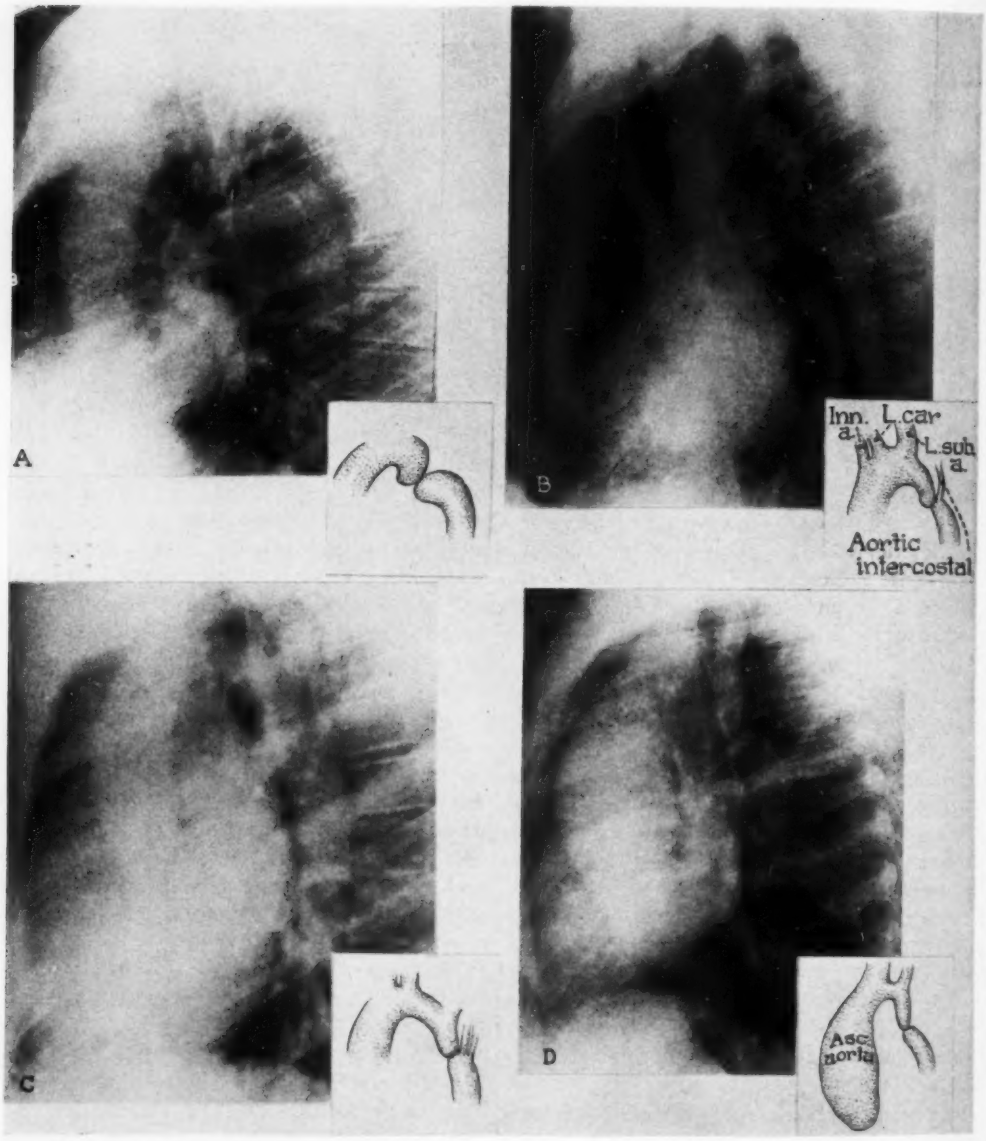



Fig. 9. Examples of angiocardiograms in which the diagnosis is not only confirmed but, in addition, satisfactory visualization is secured of the exact site and extent of the constriction.

nosis of coarctation confirmed, but in addition satisfactory visualization of the exact site and extent of the constriction was secured (Fig. 9). From a practical standpoint, this means that in only one out of three angiocardiograms were the actual coarctation site and adjacent aortic segments satisfactorily demonstrated. A summation of these angiocardiographic findings is presented in Table II.

Frequently it is possible to demonstrate some of the collateral circulation pathways, particularly those involving branches of the subclavian arteries, by angiocardiography. On occasion, the upper aortic intercostals adjacent to the post-stenotic

segment can be identified, but it is doubted that intercostal aneurysms will be demonstrated with any frequency by this method. While the visualization of these collateral pathways is of aid in substantiating the diagnosis of coarctation, their demonstration is of little practical use from a therapeutic standpoint. The same statement may be made concerning the visualization of the cardiac chambers, the pulmonary circulation, and ascending aorta with this technic.

There were no angiocardiographic fatalities in this group and, judging from the reports in the literature, the procedure is relatively harmless in cases of coarctation (31). It is only fair to state, however, that, while we have not found it necessary or deemed it advisable to use a general anesthetic, angiocardiography is not a procedure which patients find particularly pleasant, even with moderately heavy sedation.

*Aortography:* The lack of adequate visualization of the coarctation site with angiocardiographic technics in a sizable percentage of cases, both in our hands and in the experience of others, prompted the exploration of aortography as a means to more adequately demonstrate the coarctation. Jönsson, Brodén, and Karnell have reviewed the general subject of thoracic aortography, especially as it applies to coarctation, in an excellent monograph published in 1951 (13). Various technics have been devised for introducing the contrast medium into the lumen of the thoracic aorta, but our experience has been limited to two of these methods. In the majority of instances, under local anesthesia, an interarterial catheter was passed in a retrograde direction through the left radial or ulnar artery, and under fluoroscopic control its tip was placed in the distal aortic arch just proximal to the coarctation (32). On rare occasions, the lumen at the coarctation site was large enough to permit passage of the catheter into the post-stenotic segment, and direct pressure recordings could be obtained. With the patient in the lateral position,

TABLE II: EVALUATION OF CONTRAST VASCULAR STUDIES IN COARCTATION

| Status of Examination | Number of Examinations | |
|---|---|---|
| | Angiocardiogram | Aortogram |
| Diagnostic but coarctation incompletely visualized | 24 | 2 |
| Diagnostic with coarctation completely visualized | 14 | 11 |
| Totally unsatisfactory | 7 | 4 |
| Postoperative | 2 | 1 |
| TOTAL | 47 | 18 |

serial films were obtained during and immediately following the injection of a solution of 70 per cent Diodrast. In the average adult 20 to 25 c.c. were commonly used, being introduced through the catheter as rapidly as possible. In rare instances, the right arm was used, the tip of the catheter being passed down into the ascending aorta. In infants, catheters were not used, but the left radial or ulnar artery was cannulated and a solution of 35 per cent Diodrast was introduced by forceful injection in a retrograde manner. With this technic, it is usually possible in infants to secure adequate visualization of the major portion of the thoracic aorta. We have not found it necessary to use a general anesthetic in these procedures, although others have recommended that it be routinely employed (13).

Aortography was done in a total of 18 patients. One aortogram was obtained postoperatively and will not be discussed here. Four of the 17 preoperative aortograms were totally unsatisfactory for diagnostic purposes. This was usually due to an inability to introduce the catheter into the aorta, and it was presumed that arterial spasm was responsible. In 2 instances the examination was diagnostic, but the actual length of the coarctation could not be accurately determined because of inadequate filling of the post-stenotic segment. This seems more likely to occur in cases with atresia, as opposed to stenosis, at the site of coarctation. In 11 cases there was excellent visualization

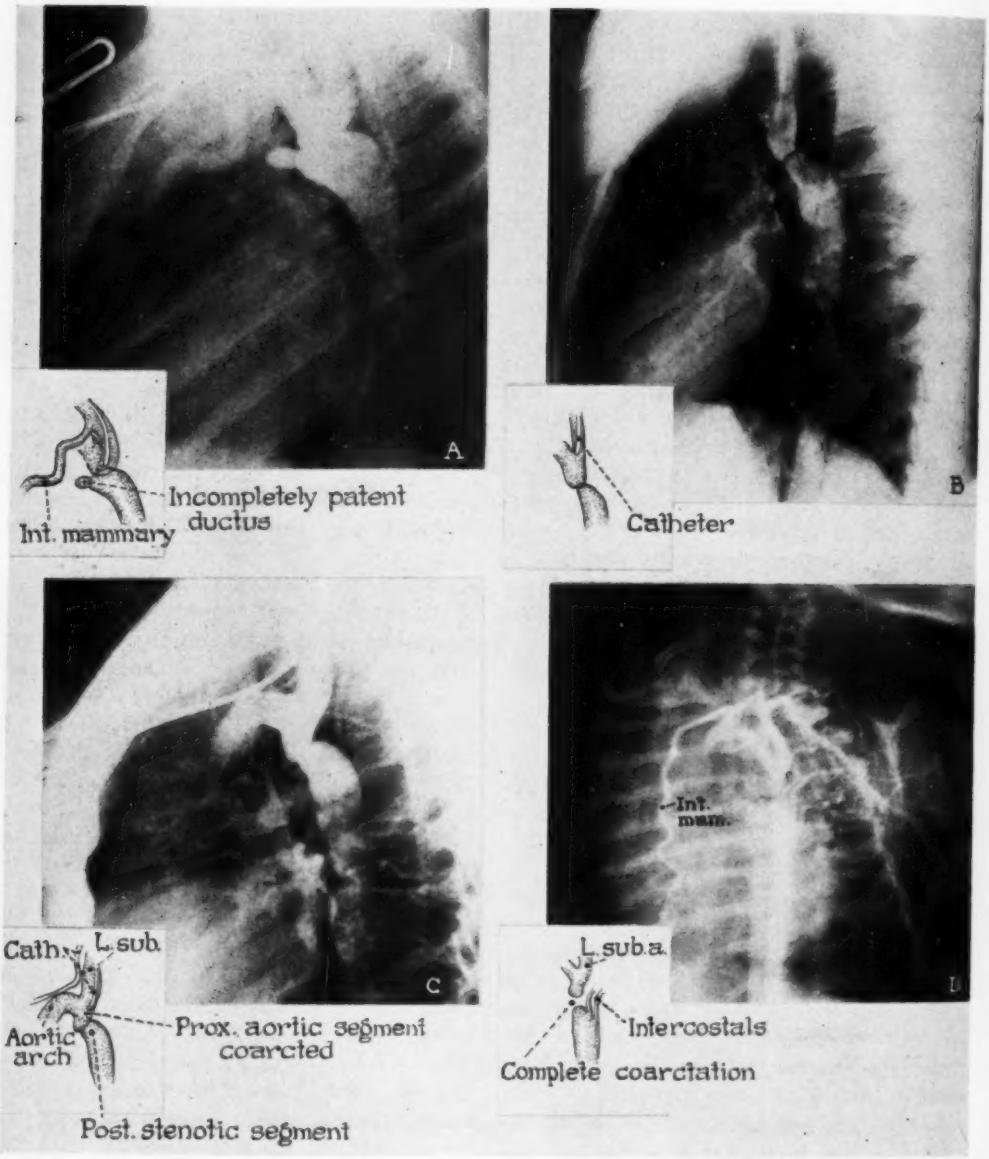



Fig. 10. Examples of aortograms in which there is excellent visualization of the coarctation site and the adjacent aortic segments. Compare with Figures 8 and 9. D is an aortogram on a 10-weeks-old baby, in whom the opaque medium was injected in a retrograde manner through a cannula placed in the left brachial artery. Note the dilated and tortuous intercostal arteries.

of the coarctation site and the adjacent aortic segments (Fig. 10). The experience with aortography is summarized in Table II.

Segments of the collateral circulation and a patent ductus may be well demonstrated on aortography (Fig. 11A), although again this is frequently of little practical therapeutic importance. Aortography may not show intercostal aneurysms with any frequency (Fig. 11C and D), and in this respect it is similar to angiocardiography.

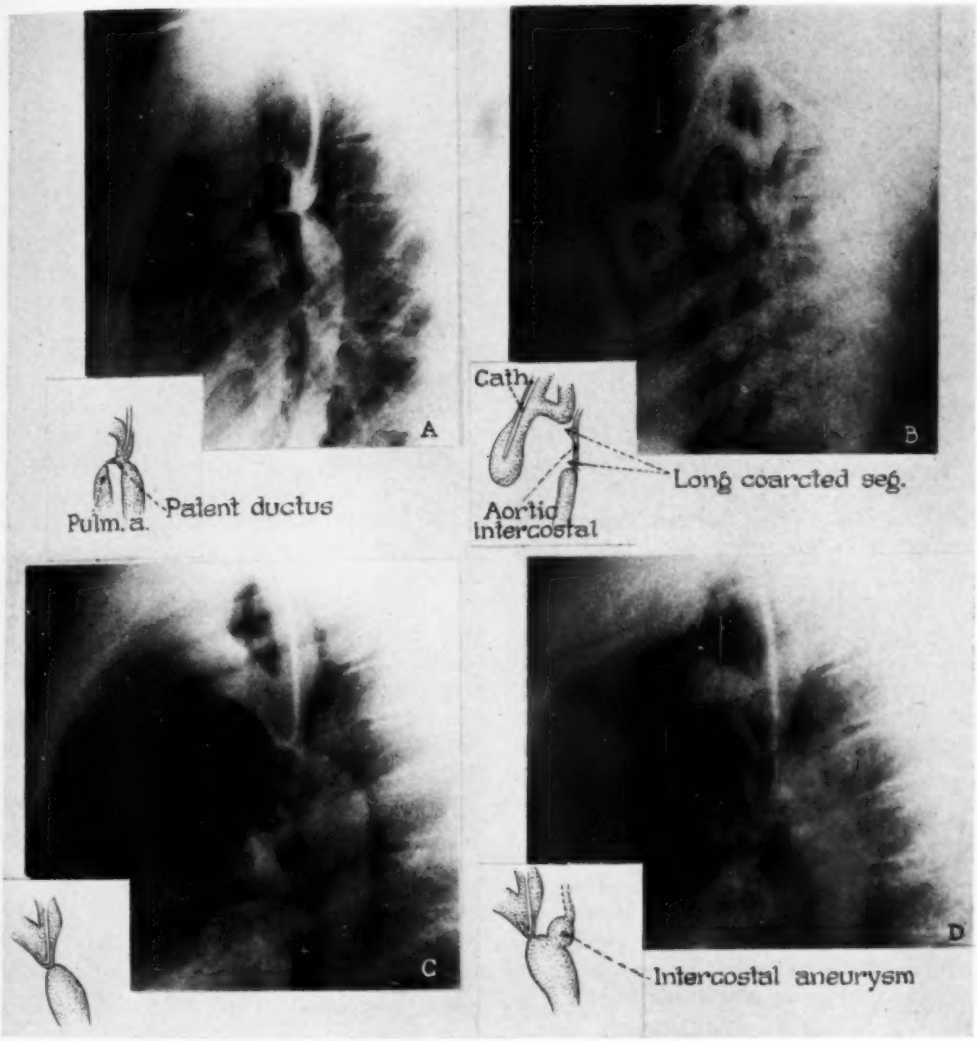



Fig. 11. A. An aortogram demonstrating the presence of a small patent ductus just proximal to the coarctation. B. An aortogram demonstrating a long coarctation segment. In this case the cathether was passed through the right arm, with its tip being placed in the ascending aorta.
C and D. Aortograms demonstrating a good-sized aneurysm of an aortic intercostal adjacent to the post-stenotic segment. The aneurysm did not opacify until late in the series (D), indicating that filling is taking place by way of collaterals, and not from the adjacent aorta.

There is no question that aortography in general will give a more satisfactory visualization of the coarctation site than will angiocardiography. There are, however, certain objections to aortography, the most serious of which seems to be that it carries an increased risk as compared to angiocardiography. There were no fatalities in the current series, but in our overall experience with aortography in congenital cardiovascular disease there have been two fatalities. In one of these a catheter was being passed under fluoroscopic control in a young child in poor general condition. A considerable hemorrhage occurred from the operative incision but was not noticed

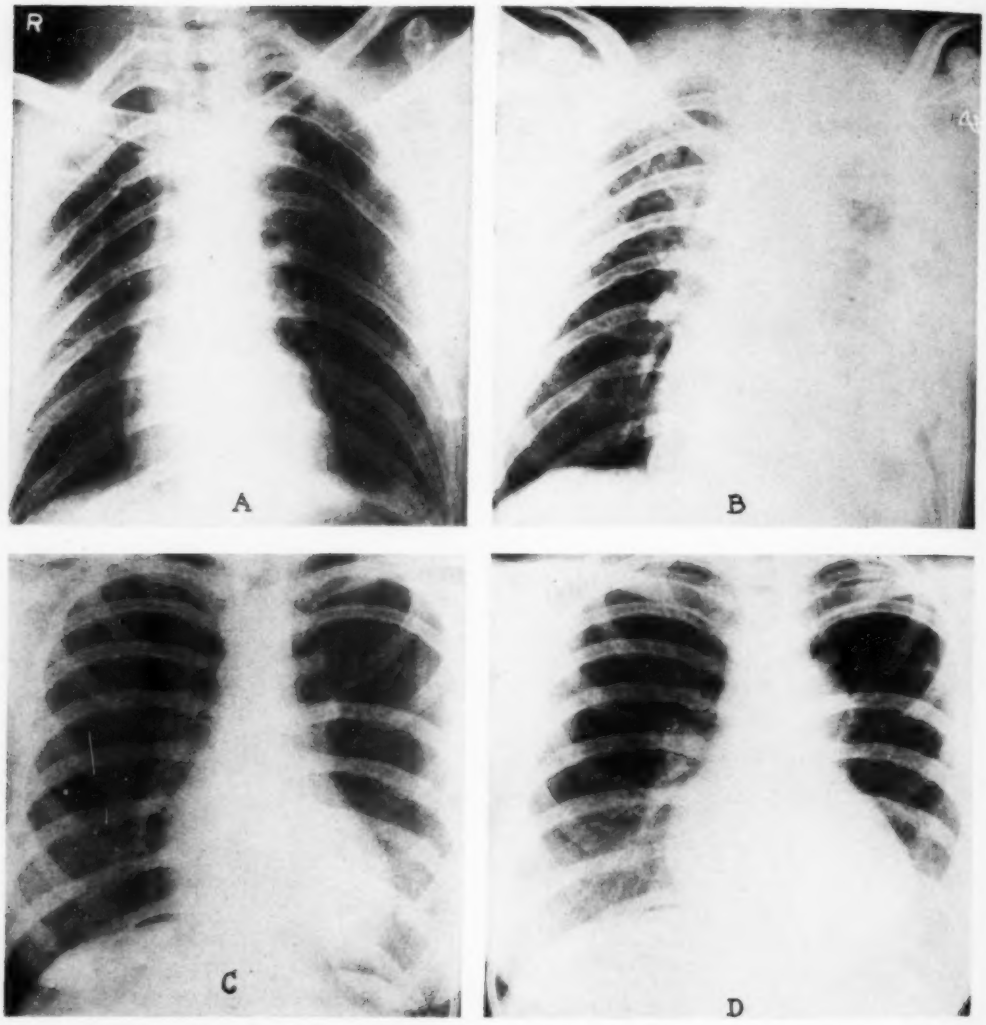



Fig. 12. Examples of postoperative complications following surgical repair of coarctation.
A. A portable film on the third postoperative day, revealing an essentially clear chest.
B. A portable film on the tenth postoperative day on the same patient, revealing diffuse opacification of the left hemithorax secondary to massive hemorrhage into the pleural space.
C. A postoperative discharge film revealing a relatively normal left mediastinal border in the region of the repaired coarctation.
D. A five-month follow-up film on the same patient, revealing a rounded soft-tissue mass in the operative region. This was proved to be an aneurysm at the anastomotic site.

in the darkness of the fluoroscopic room. Death followed a few hours later, and it was felt that the hemorrhage had been at least a contributing factor. In the other case, the tip of the catheter was placed under fluoroscopic control in the distal aortic arch. The patient was then moved to the radiographic table and positioned, and the contrast medium was injected. A convulsoin occurred shortly thereafter, starting in the contralateral foot, with an eventual fatal outcome. The films revealed that the tip of the catheter had slipped up into the left common carotid artery, and that all of the contrast medium had passed distally into that vessel. It

may be argued that both of these fatalities were avoidable, but nevertheless they occurred.

In the current series of aortograms, there was one non-fatal but potentially serious complication which seemed to be related to the procedure. In this instance, the tip of the catheter was placed in the usual manner in the distal aortic arch just proximal to the coarctation. The patient was placed in the proper position on the radiographic table and, as is our custom, a test injection was made with saline. As this was done, the patient complained bitterly of pain in the upper back. The catheter was withdrawn slightly, and the injection of saline cautiously repeated without any resultant discomfort. The contrast medium was then introduced and a satisfactory aortogram was obtained. At exploratory thoracotomy the following day, there was a fresh dissecting aneurysm involving only the immediate post-stenotic segment. The exact series of events was never clearly understood, but it was presumed that the tip of the catheter must have been snugly wedged against the coarctation site and that the injected saline had initiated the limited dissection.

*Postoperative Complications*

The complications following the surgical repair of coarctation of the aorta include not only those which are incident to any exploratory thoracotomy, but also those dependent upon the particular type of surgery involved. Among the latter, only one has any real radiologic significance, and this occurs when there is a breakdown of the anastomotic suture line. This may result in an extensive and usually fatal hemorrhage, or in the formation of an aneurysm at the anastomotic site. The development of bacterial endarteritis upon the anastomosis increases the likelihood of such an event.

There were four postoperative fatalities in the current series secondary to an anastomotic breakdown. One patient became febrile and had a hemoptysis on the thirteenth postoperative day. A radiograph at that time revealed a prominence of the left mediastinal border in the region of the anastomosis which had not been present on earlier postoperative films. Death occurred suddenly the following day, and at autopsy it was found that there had been a partial tear in the suture line, with massive hemorrhage into the left pleural space. It was presumed that the mediastinal prominence demonstrated radiologically represented an initial localized hematoma. In another instance clinical and radiological evidence of massive hemorrhage occurred on the tenth postoperative day, with death ensuing within a few hours during an emergency thoracotomy. Roentgenography showed a diffuse opacification of the left hemithorax, which had been essentially clear prior to that time (Fig. 12A and B). The hemorrhage is not always so massive as to be suddenly fatal, as evidenced by a case in which there was continued bleeding over a period of almost two weeks. Two exploratory thoracotomies were attempted during this period, but definitive repair was not feasible, and death eventually occurred from further hemorrhage. The final fatality was in a patient who returned five months following an apparently successful repair of a typical coarctation, complaining of recent chest pain. Routine radiographs revealed in the region of the anastomosis a rounded bulge projecting to the left and posteriorly, which had not been present on earlier postoperative films (Fig. 12C and D). It was felt that an aneurysm had developed at the anastomotic site. Angiocardiograms confirmed this impression and showed the wall of the aneurysm to be relatively thin. While in the hospital for evaluation, the patient experienced increasingly severe chest pain. An exploratory thoracotomy was undertaken, and an attempt was made to plicate the aneurysm. Death occurred rather suddenly one week later, and at autopsy it was found that the aneurysm had ruptured into the left pleural space.

## DISCUSSION

There has now been enough accumulated experience with coarctation to evaluate the role that should be played by radiology and the radiologist in its diagnosis and treatment. It is true that the condition is relatively uncommon and that, therefore, a large number of cases will be seen only in those medical centers where congenital vascular surgery is being performed. Nevertheless, initially these patients have a wide geographic distribution, and it is the local radiologist who may have one of the first opportunities to make the correct diagnosis. Once the possibility of coarctation is considered, by either the radiologist or the local physician, its presence can be easily confirmed by a combination of routine physical and radiologic studies in the great majority of instances. The only group of cases offering any real diagnostic problem occurs in young children. Here the coarctation may be complicated by additional anomalies and, in general, routine radiologic studies in this group have little to offer in terms of the diagnosis of coarctation. Both diagnostic and therapeutic aspects of symptomatic coarctation in infants vary considerably from those of the older age groups (33, 34). It is planned to enlarge upon this aspect of the subject in a later publication.

Once the diagnosis has been established, unless there are obvious contraindications to surgery, the patient should if possible be referred to one of the centers specializing in the treatment of coarctation. There his condition will be re-evaluated, and part of this process will center around the radiologic aspects of the case. The problem immediately arises as to the role of contrast vascular studies in such an evaluation. It is our feeling that these procedures should be utilized only in selected cases. We have been impressed by the finding that in the great majority of clinically significant coarctations the anomaly is located at a specific anatomical site and that its nature is such that a skillful and experienced surgeon can successfully resect the stenotic area and restore the aortic continuity by an end-to-end anastomosis. In other words, if surgeons routinely performed a left thoracotomy through the bed of the fifth rib in patients with a clinical diagnosis of uncomplicated coarctation, they would in approximately 90 per cent of the cases find a lesion of this typical type. If aortic grafts were available, the operability would rise to the neighborhood of 95 per cent. The only real difficulty would occur in those relatively rare instances where the coarctation is not located at the usual site, and in these cases a clue as to the abnormal location may be obtained on routine physical examination. For example, if the coarctation involves or is proximal to the origin of the left subclavian artery, there will usually be significant differences in the blood pressures of the upper extremities. Or, if the coarctation is located in the abdominal aorta, the murmurs and collateral circulation pathways may show distinct variations from the usual findings.

For these reasons it is felt that in the great majority of cases careful physical examination and routine radiologic studies will adequately indicate the site of coarctation. It should be emphasized that by routine radiologic study a single standard chest film is not implied. In addition, there must be included fluoroscopy, barium-swallow films in the routine projections, and adequate attempts to demonstrate the figure "3" sign. It is believed that contrast vascular studies should be limited to those instances where there is some reason to suspect that the coarctation is atypical, or where routine radiologic studies give no clear indication of the site of the stenosis.

If, under these conditions, contrast studies are deemed necessary, aortography will in general provide a more adequate visualization of the coarctation, although it apparently carries a greater risk than does angiocardiography. Regardless of the type of contrast study used, consistently satisfactory results will not be obtained unless the equipment permits the obtaining of serial films.

## SUMMARY

The experience with 125 surgically confirmed cases of coarctation of the aorta has been presented.

From a practical therapeutic standpoint, it has been found that these cases could be divided into three groups, depending upon the anatomical location and effective length of the coarctation. In the great majority of instances the anomaly was located in the distal aortic arch and it was surgically feasible to resect the stenosis and reestablish the aortic continuity by an end-to-end anastomosis.

Emphasis has been placed upon the radiologic findings in these cases, including both routine radiologic studies and contrast vascular examinations. In general our radiologic experience has been similar to that reported by other groups. Aortography usually gives more satisfactory visualization of the coarctation site than does angiocardiography, although in our experience it carries a greater risk.

It has been suggested that contrast vascular technics be employed routinely only in those instances where there is a suspicion that the coarctation is atypical or where routine radiologic studies give no clear indication as to the site of the stenosis.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## SUMARIO

### Coartación de la Aorta: El Aspecto Roentgenológico de 125 Casos Confirmados Quirúrgicamente

Présentanse aquí las observaciones realizadas en 125 casos, confirmados quirúrgicamente, de coartación de la aorta en enfermos cuya edad variaba de diez semanas a cuarenta y un años. Desde un punto de vista práctico, notóse que esos casos podían dividirse en tres grupos, conforme a la localización anatómica y la longitud efectiva de la coartación. En la gran mayoría de los casos (111), la anomalía comprendía la porción distal del cayado, y resultaba factible quirúrgicamente resecar la parte estrechada y restablecer la continuidad aórtica por medio de una anastomosis términoterminal. En otro grupo de casos (10), la coartación estaba situada en su lugar habitual, pero su longitud efectiva y naturaleza eran tales que, después de la excisión, no era factible el establecimiento de una luz aórtica adecuada mediante una anastomosis términoterminal. En el tercer grupo de casos (4) la coartación no estaba radicada en su sitio de costumbre.

Recálcanse los hallazgos radiológicos en estos casos, comprendiendo tanto los habituales estudios radiológicos como exámenes vasculares de contraste. En general, las observaciones radiológicas de los AA. han sido semejantes a las descritas por otros grupos. La aortografía suele facilitar una visualización más satisfactoria del sitio de la coartación que la angiocardiografía, pero entraña mayor riesgo. Propónese que, en general, no se empleen técnicas vasculares de contraste más que en los casos en que se sospecha que la coartación es atípica o en que los estudios radiológicos corrientes no aportan ninguna indicación neta en cuanto al sitio de la estenosis.

## DISCUSSION

**Frederic N. Silverman, M.D.** (Cincinnati, Ohio): The diagnosis of coarctation of the aorta in young infants is probably more important than is indicated in Dr. Sloan's presentation, even though he did report that 21 of 24 cases discovered at autopsy occurred in this group. The association of coarctation with other serious cardiovascular malformations in young infants should not deter us from attempts at correction of the coarctation. If death is the result of cardiac failure in uncomplicated coarctations, similar cardiac failure is likely to be an important contributing factor in death in those cases with other malformations. The elimination of this factor by surgical attack on one malformation readily identified clinically, and confirmed by the technics described by Dr. Sloan, may permit subsequent surgical attack on the other malformations. The feasibility of surgery in young infants is attested to by the fact that his youngest patient was but ten weeks of age, and ours sixteen weeks.

I am happy to see the classification into infantile and adult types discarded—the classification suggested is of importance to the surgeon and is capable of being clearly defined by the radiologist.

The placement of the catheter tip in the ascending arch of the aorta is not without danger; depression of the S-T segment and inversion of the T

waves in electrocardiograms, even in angiocardiography, indicate that the coronary circulation may be impaired and that the relationship of the tip of the catheter to the semilunar cusps may be very important. Whenever the medium is injected, by whatever technic, into the aorta proximal to the coarctation, the carotids should be digitally occluded to prevent a high concentration of the substance from reaching the brain.

Aortic grafts are not immediately available in all centers prepared to perform definitive surgery for cardiovascular anomalies. Notwithstanding the fact that aortograms were only about 60 per cent effective in Dr. Sloan's series, it is well to remember that the procedure is simpler for all concerned than is a thoracotomy for the identification of an anomaly unsuitable for end-to-end anastomosis.

# The Superior Vena Cava Obstruction Syndrome in Bronchogenic Carcinoma

## Pathologic Physiology and Therapeutic Management[1]

B. ROSWIT, M.D.,[2] G. KAPLAN, M.D.,[3] and H. G. JACOBSON, M.D.[4]

THE ONSET of the superior vena cava obstruction syndrome in a patient with a bronchogenic carcinoma is an ominous event, heralding inoperability and producing severe discomfort and curtailment of useful activity. Unless decompression therapy is promptly and effectively instituted, the course is rapidly progressive, characterized throughout by distressing signs and symptoms. In our experience with a series of 38 such patients, roentgen therapy and/or nitrogen mustard[5] have provided a striking degree of palliation and prolongation of useful activity in a majority of cases.

The pathologic physiology and therapeutic management of this important complication deserve far more generous consideration than they have heretofore been afforded in the literature. Particularly is this so because of the rapidly rising incidence of bronchial cancer in recent years, the relative frequency of obstruction of the superior vena cava in the natural history of that disease, and the striking benefits of prompt treatment with x-rays and/or nitrogen mustard.

In earlier communications (19, 20, 21), the authors reported on the use of nitrogen mustard as an adjunct to radiation in bronchogenic cancer, with therapeutic results in 40 patients, among them 9 with the superior vena cava obstruction syndrome. It is proposed, in the present paper, to discuss the pathologic physiology, clinical picture, radiographic features, and therapeutic management of this syndrome in the light of our broader experience.

### PATHOLOGIC PHYSIOLOGY

The superior vena cava is the major trunk line for the return of venous blood to the right heart from the head, neck, upper extremities, and upper thorax (see Fig. 1A). This important channel is particularly vulnerable to obstruction by primary bronchial cancer or metastatic mediastinal nodes because (*a*) it is a thin-walled vessel with very low venous pressure, (*b*) it is locked in a tight compartment in the right anterior-superior mediastinum behind an unyielding sternum, (*c*) it is in intimate proximity to the right main bronchus, and (*d*) it is completely encircled by chains of highly important lymph nodes which drain all of the structures of the right thoracic cavity and the lower part of the left (5, 14, 22). In front of the superior vena cava lie the right anterior mediastinal or prevascular nodes. Behind it lurk the right lateral or paratracheal nodes, the lowermost and largest of which threatens the arch of the vena azygos, the great vein's most vital auxiliary (see Fig. 1B, C, D). Rouvière (22), Drinker (5), and McCort and Robbins (14) have recently added greatly to our knowledge of this important lymphatic drainage system in pulmonary cancer.

With these anatomic and physiologic facts at hand, one can readily explain our observation that (*a*) superior vena cava obstruction is relatively frequent in the natural course of bronchogenic carcinoma (15 per cent in our series), (*b*) it is most frequently encountered in lesions of right bronchial origin (80 per cent in our series),

[1] From the Radiotherapy Department, Radiological Service of the Veterans Administration Hospital, Bronx, N. Y. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

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[5] Nitrogen mustard (Mustargen) supplied through the courtesy of Merck and Company, Rahway, N. J.

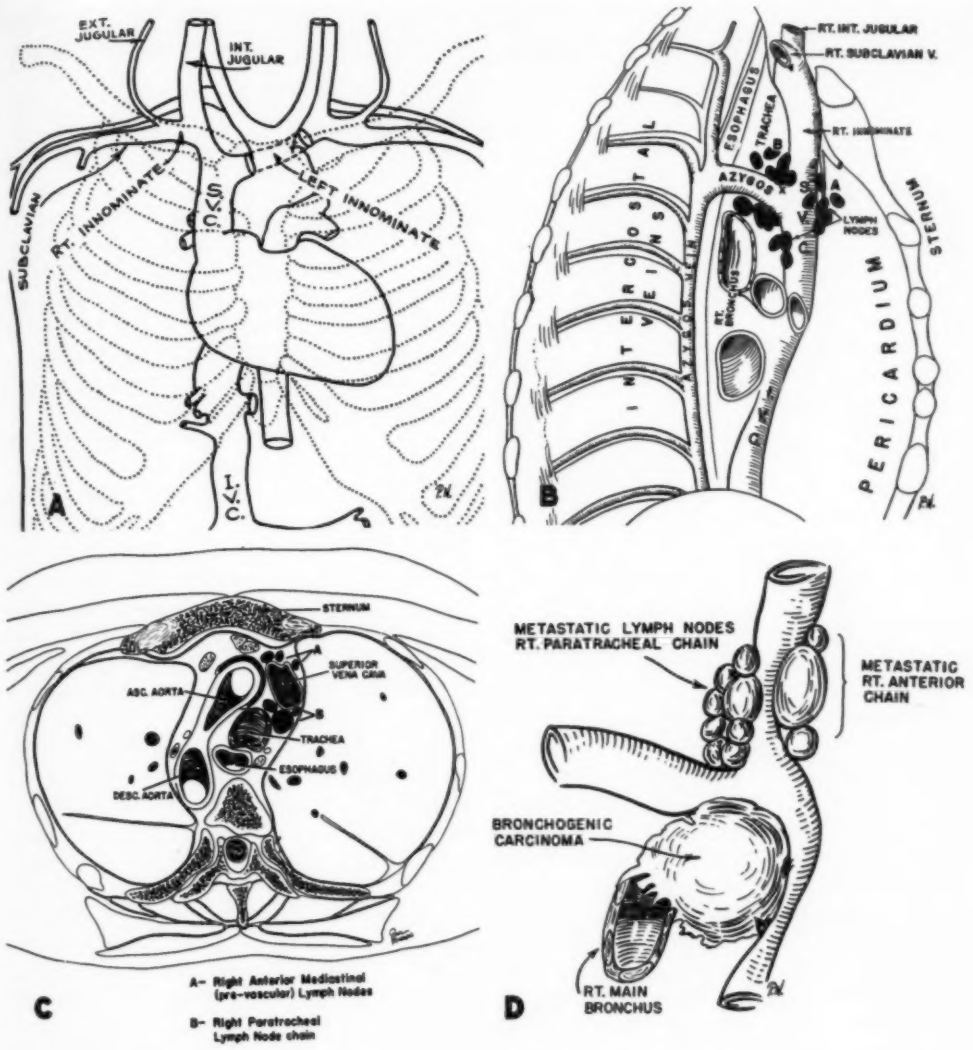


Fig. 1. Schematic drawings of pathologic physiology of the superior vena cava obstruction syndrome.
A. Schematic drawing of the superior vena cava and its principal tributaries in relation to the thoracic cage.
B. Schematic drawing illustrating the remarkably vulnerable position of the superior vena cava and the vena azygos in relation to (1) carcinoma of the right main bronchus and (2) lymph node groups nearly always involved by bronchogenic carcinoma: (A) anterior prevascular nodes, (B) right paratracheal nodes.
C. Schematic cross-section drawing of the superior mediastinal compartment at the level of the first intercostal space. Note the vulnerable position of the superior vena cava in relation to lymph node groups nearly always involved by bronchial cancer.
D. Schematic drawing illustrating dynamic changes in the superior vena cava and the vena azygos resulting from obstruction by the most important etiologic factor—bronchogenic carcinoma.

and (*c*) it is nearly always associated with bronchial neoplasms of the anaplastic variety with unusual growth potential (90 per cent in our series). Steinberg and Dotter (23) found this complication in 17 per cent of 100 preoperative bronchial cancer cases studied by angiocardiography. Rosenbloom (18) reported 8 cases of superior vena cava obstruction, all of right-sided bronchial origin and all of anaplastic his-

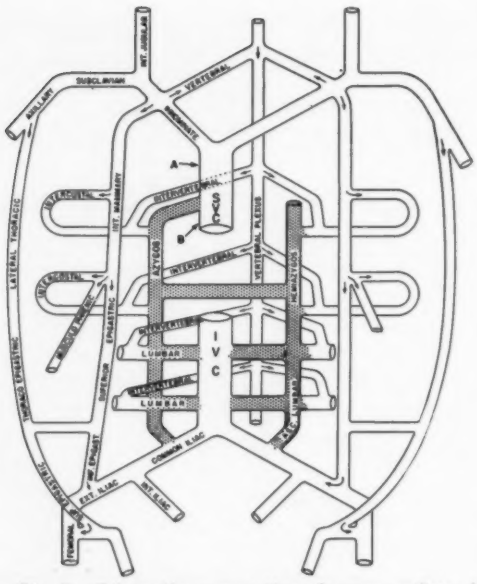


Fig. 2. Schematic presentation of venous collateral systems in obstruction of the superior vena cava: azygos, vertebral, internal mammary, and lateral thoracic. Redrawn from McIntire and Sykes: Ann. Int. Med. **30**: 925–960, May 1949.

tology, with a period of onset of less than six weeks in 4 of the cases.

Interruption of blood flow in the great vein is accomplished by the primary bronchial neoplasm or invaded lymph nodes, principally through external compression, occasionally by intraluminal invasion, and rarely by actual thrombosis. Bronchogenic carcinoma in recent years is overtaking syphilitic aortic aneurysm as the principal etiologic factor in the superior vena cava obstruction syndrome. This is apparently the result of several factors, including the successful chemotherapeutic attack upon syphilis, the rapidly rising incidence of bronchogenic carcinoma, and the poor salvage (5 per cent) by thoracic surgery in this neoplastic disease.

In our own experience during the last five-year period, we have encountered the following etiologic factors: bronchogenic cancer (in 38 cases), syphilitic aortic aneurysm (in 4 cases), malignant lymphoma (in 4 cases), mediastinal fibrosarcoma (in 2 cases), and metastatic cancer in mediastinal lymph nodes from the breast (1 case), thyroid (1 case), and pancreas (1 case) (see Fig. 3).

## COLLATERAL CIRCULATION

As soon as the major venous trunk line or its tributaries become compromised by extrinsic pressure or actual invasion, a magnificent collateral system begins shouldering the burden of returning venous blood to the right heart from the head, neck, upper extremities, and upper thorax (see Fig. 2). Upon the efficiency of this collateral circulation rest the patient's comfort, degree of disability, and immediate prognosis. The site, the rate, and the extent of obstruction will further determine the nature and severity of the clinical signs and symptoms. Most of our patients were in great distress when first seen, with the rapid induction of the full-blown clinical syndrome by fast-growing, highly anaplastic lesions. Their collateral circulation was obviously inadequate and their immediate prognosis grave.

When the obstruction is *above* the azygos vein, this major auxiliary channel takes over the function of the superior vena cava. The majority of our patients were in this group. The system of collaterals is here less elaborate and is found principally in the prominence of the veins of the neck, shoulder girdles, and upper thorax (Fig. 3A). Venous blood from the head and neck now proceeds toward the heart *via* the external jugular vein and thence to a superficial plexus on the anterior chest wall which connects with the perforating branches of the internal mammary and intercostal veins, finally joining the azygos system to enter the superior vena cava *below* the site of obstruction (Fig. 3C).

When the obstruction occurs *below* the azygos arch or includes it, the patient tolerates it with far more difficulty. The venous pressure is much higher and the immediate prognosis more serious. Carlson's (2) experimental surgery in dogs clearly indicates the grave nature of obstruction below the entry of the vena azygos. The route of venous blood flow to the right heart is now much more circuitous

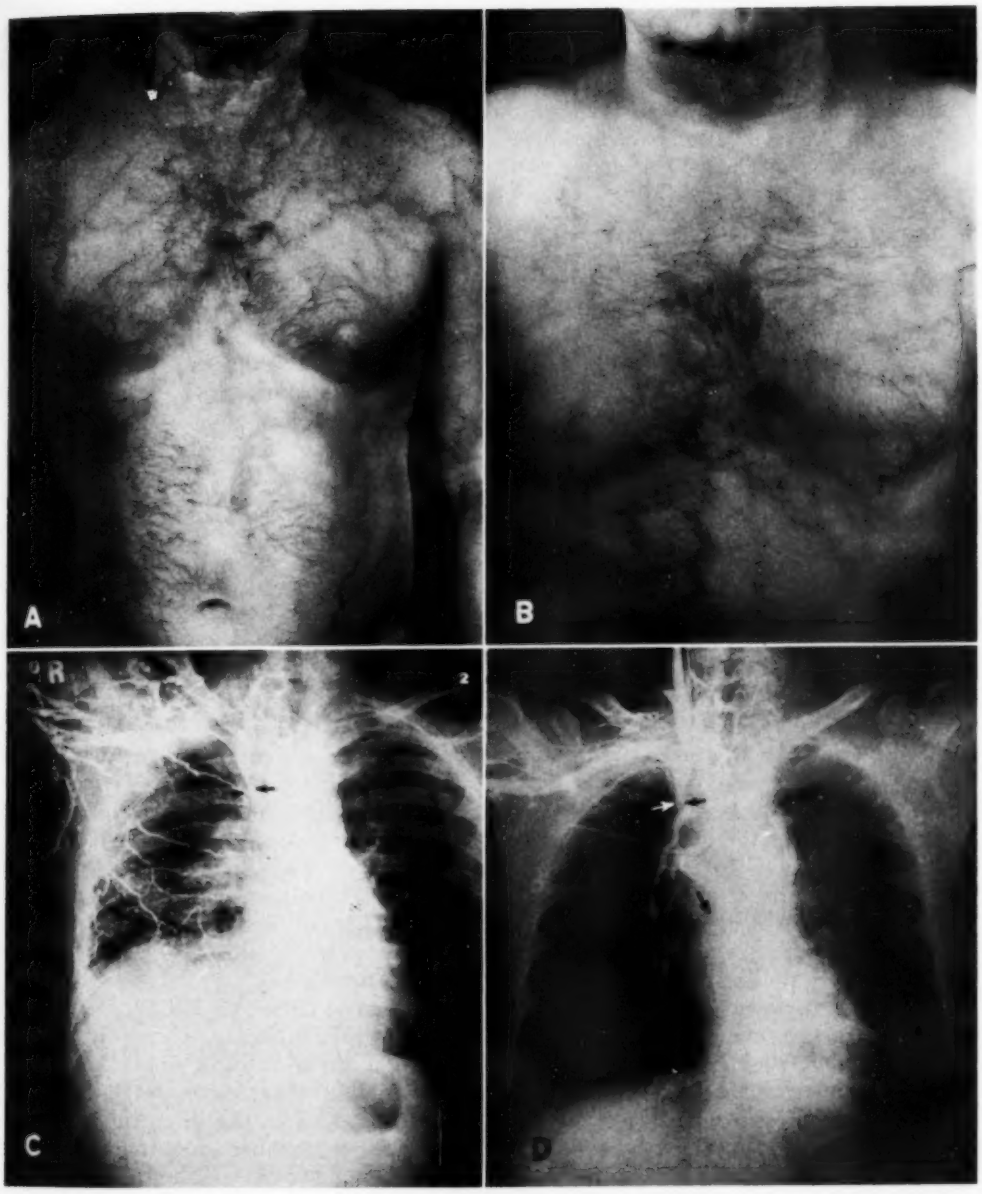


Fig. 3. A. Infra-red photograph of superficial venous collaterals in a patient with superior vena cava obstruction at a point *above* the entry of the vena azygos. Note the elaborate pattern of collaterals on the *upper* thorax.

B. Infra-red photograph of patient with superior vena cava obstruction *below* the entry of the azygos vein. Elaborate superficial collaterals were demonstrated on the *lower* abdomen and groin.

C. W. H. Note opacification of right subclavian and internal jugular veins to join the right innominate, but the superior vena cava is blocked. Striking degree of superficial collateral circulation via intercostals en route to azygos vein and right auricle.

D. J. G. Right innominate vein and its tributaries opacified and dilated. Obstruction at point of entry into superior vena cava. Note dilated opacified azygos vein. The superior vena cava is not filled. Considerable deep collateral circulation may be noted to the azygos vein en route, in reverse direction, down to inferior vena cava.

and complex and involves the support of the inferior vena cava. The collecting circulation, superficial and deep, of the lower abdominal wall, the back, and the groin is utilized for this purpose, carrying blood to the inferior vena cava *via* the femoral and iliac veins (Fig. 3B and D).

The interesting details of this complex and intriguing collateral circulation were best described in detail by McIntire and Sykes (15) in 1949. There are four important collateral routes for carrying venous blood around the obstruction and back to the right heart. They include the internal mammary, vertebral, azygos and lateral thoracic systems, depicted in the schematic drawing in Figure 2.

## CLINICAL PICTURE

The superior vena cava obstruction syndrome in bronchial cancer is a grave symptom-complex which grows in severity as the venous pressure mounts in the great vein and its tributaries. The patient experiences progressive dyspnea, cough, and orthopnea, aggravated greatly in the prone position. He is soon able to breathe only in the erect posture and dares not lie down. There is progressive edema of the head, neck, and upper extremities and a peculiar reddish cyanosis of the skin which grows more intense on recumbency. Most striking is the pattern of superficial venous collaterals on the neck, chest, and abdomen (Fig. 3A and B). The prominence of these collateral veins, however, is not a dependable guide to the severity of the symptom-complex or to the therapeutic response. Far more important are the symptomatology, venous pressure, and radiographic findings. As the cerebral venopressure rises, the patient suffers headaches, vertigo, drowsiness, stupor, and unconsciousness. Unless decompression therapy with x-ray irradiation and/or nitrogen mustard is effective, death comes finally as a result of cerebral anoxemia, failure of the respiratory center, or strangulation-edema of the glottis and respiratory passages.

Venous pressure measurements in the upper extremities are invariably increased well above 150 mm. saline and in most of our cases reached a level above 300 mm. The femoral vein readings are usually normal.

## RADIOGRAPHIC FEATURES

Conventional radiographs of the chest afford only limited information regarding the superior vena cava in normal and pathologic states. In the postero-anterior view, the great vein can often be seen forming the uppermost part of the right margin of the cardiac shadow, beginning at the right clavicle and extending down in a vertical course to the curve of the ascending aorta. The outward turn at the clavicle is due to the right contour of the innominate vein. (See Fig. 1A.)

Conventional films in all of our cases revealed a large space-occupying tumor representing metastatic lymph nodes in the anterior-superior mediastinal compartment, directly in the path of the superior vena cava (Figs. 4–6). Other roentgen stigmata of bronchogenic carcinoma were nearly always present. Most authors report that the right-sided lesions slightly outnumber those on the left. McCort and Robbins (14), however, observed 56 left-sided lesions, as against 47 arising on the right, of which 25 per cent originated in the right main or right upper lobe bronchus. It is significant that in our superior vena cava obstruction cases the right-sided lesions outnumber the left by a ratio of more than 4 to 1. Of 30 lesions found in the right bronchial tree, 90 per cent arose in the right main or right upper lobe bronchus in close proximity to the superior vena cava and to the important draining lymph nodes behind and in front of the superior vena cava.

The site and nature of the obstruction as well as the pattern of collaterals can best be determined by phlebography or angiocardiography. Several authors have contributed greatly toward our knowledge of these changes by angiocardiographic methods (1, 4, 16, 17, 23, 24). Katz, Hussey, and Veal (11) are convinced that the phlebographic technic, in association with com-

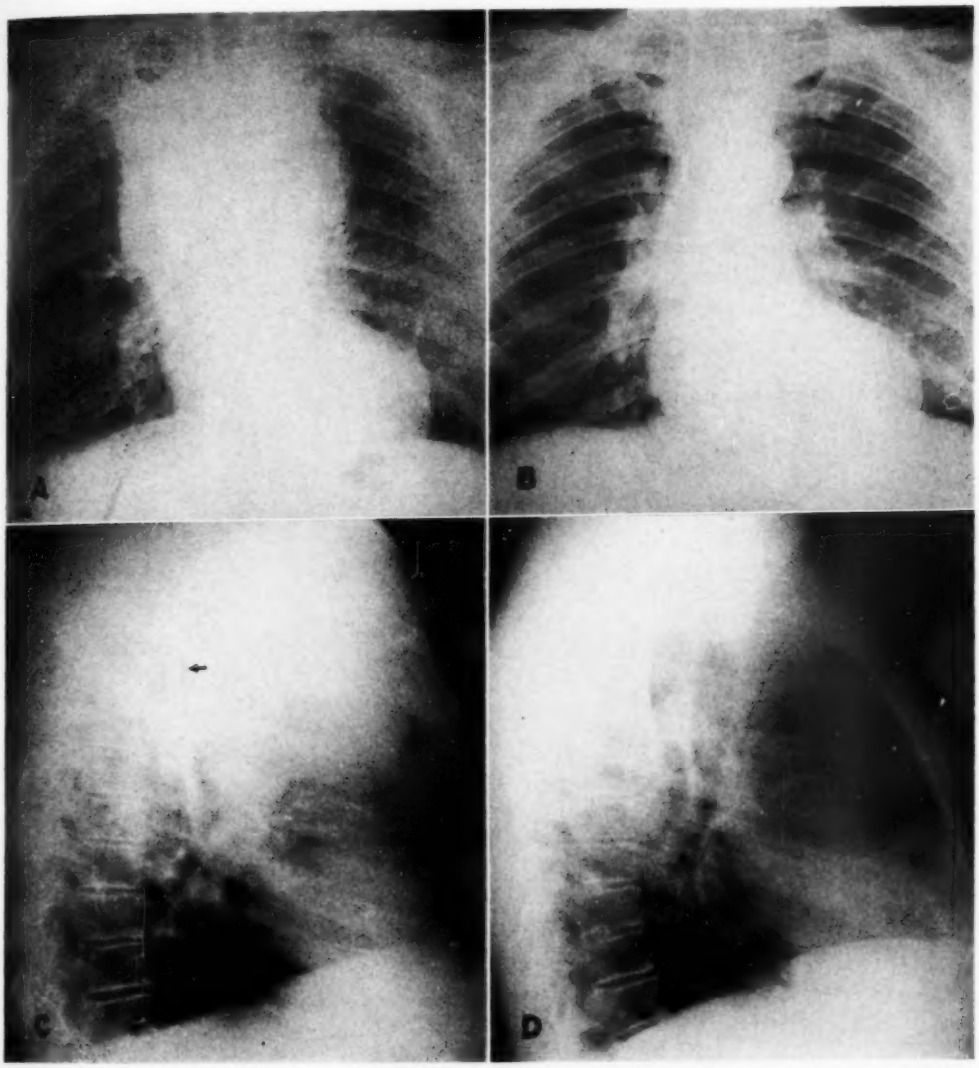


Fig. 4. C. L., 57-year-old coal miner with brief history (one month) of dyspnea, orthopnea, swelling of head and neck, and extensive superficial collaterals visualized on the trunk. Anaplastic epidermoid carcinoma, right upper lobe bronchus. Patient received 3,500 r to the mediastinal tumor in fifty-one days. A remission of one year followed this single course of roentgen therapy.

A. Postero-anterior chest film before treatment. Note massive paramediastinal tumor, somewhat more pronounced on the right.

B. Postero-anterior chest film after treatment, 3,500 r in fifty-one days. Note almost complete disappearance of the enlarged mediastinal lymph nodes and primary neoplasm as well.

C. Right lateral chest film of same patient before treatment. Note huge mass in anterior-superior mediastinal compartment, compressing and displacing the trachea posteriorly.

D. Right lateral chest film of same patient after treatment. The mass is no longer visible and the trachea now appears normal in position and caliber.

parative measurements of the venous pressure, affords unequaled precision for localization of venous obstruction in bronchogenic carcinoma and for determining the extent and efficiency of the collateral circulation. It provides anatomic details that otherwise would be obtainable only by dissection. These authors offer a full

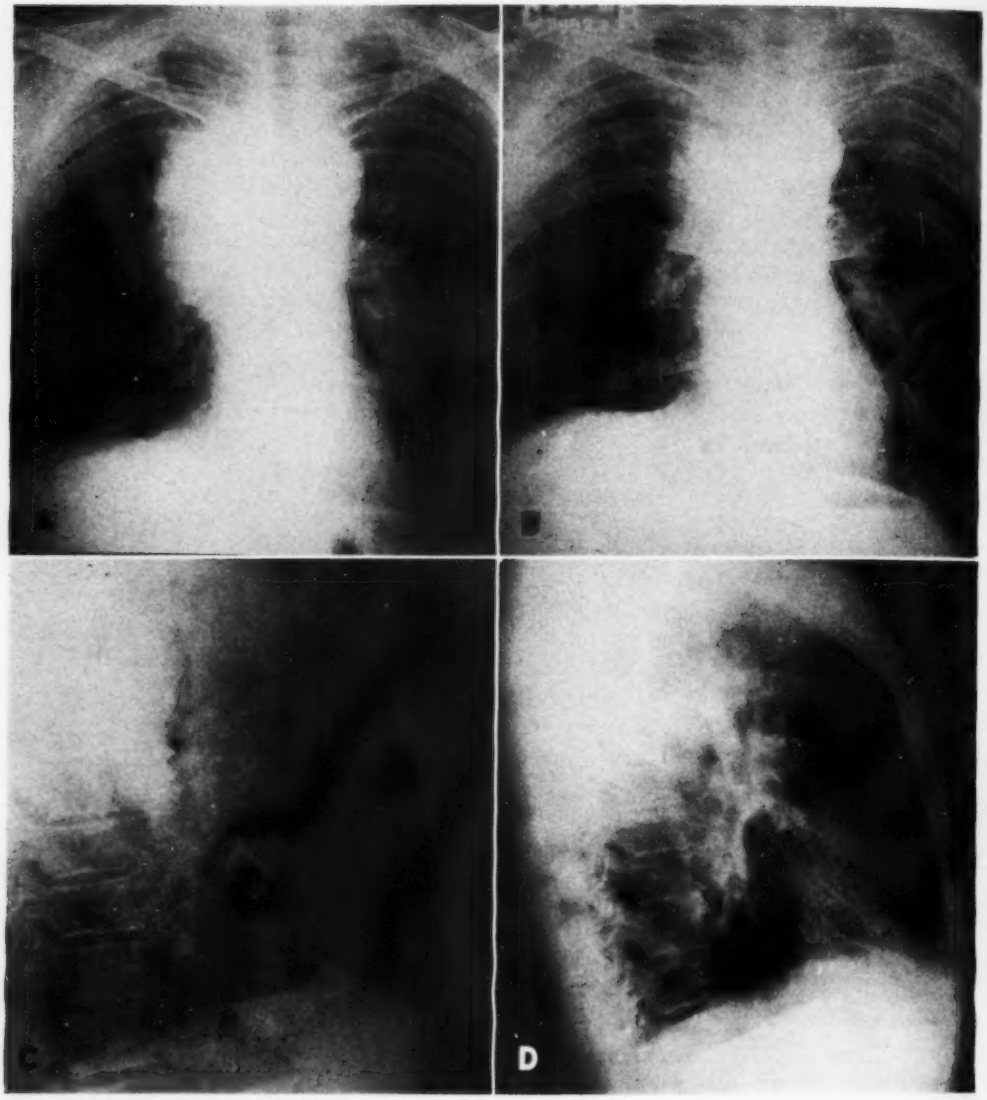


Fig. 5. J. K., 63-year-old white male, with severe dyspnea, orthopnea, swelling of head and neck, cyanosis, and distention of superficial veins of neck, thorax, and abdomen. Anaplastic epidermoid Grade IV bronchogenic carcinoma, right upper lobe bronchus. Patient received 4,000 r to the mediastinum in sixty-nine days through two portals, with the grid. Improvement began after 500 r tumor dose and complete remission was accomplished for more than eight months after the single course of roentgen therapy.

A. Postero-anterior chest film before treatment. Note large right paramediastinal mass.

B. Postero-anterior chest film after treatment, 4,000 r in sixty-nine days. Note striking reduction in irradiated tumor mass.

C. Right lateral chest film before treatment. Note again large mass occupying the anterior-superior mediastinal compartment.

D. Right lateral chest film showing marked reduction in tumor after roentgen therapy.

appraisal of the value and limitations of phlebography in cases of superior vena cava obstruction.

It has recently become our established practice to perform angiocardiography in all patients with known or suspected bron-

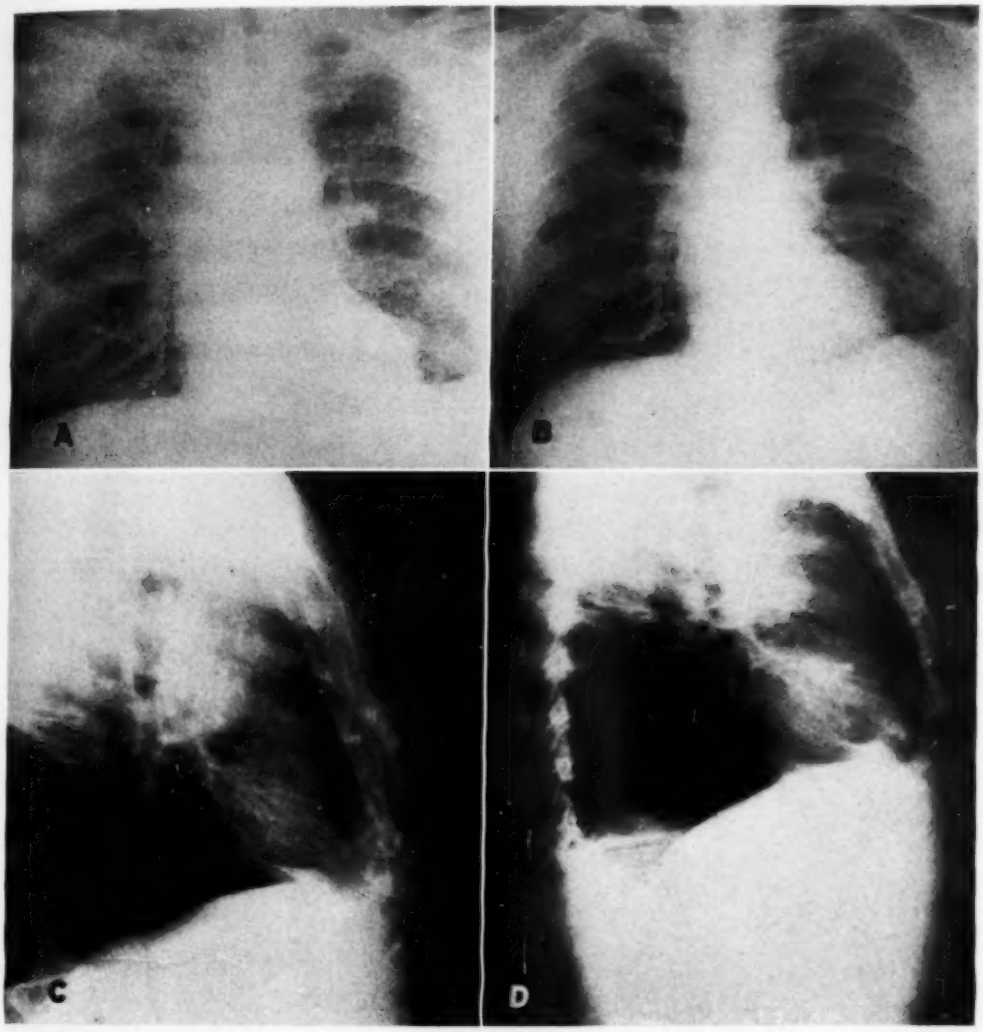


Fig. 6. A. J. L., 51-year-old white bartender, with dyspnea, orthopnea, swelling of head and neck, and external evidence of extensive collateral circulation. Patient critically ill and in great distress. Anaplastic epidermoid carcinoma of right upper lobe bronchus. Patient received mediastinal tumor dose of 2,660 r in sixty days through four cross-firing portals, with a remission of six months. Recurrence of neoplasm and symptoms was again treated with 2,800 r tumor dose, for an additional remission period of two months.

A. Postero-anterior chest film before treatment. Note parahilar and paratracheal mass.

B. Postero-anterior chest film after first course of treatment, 2,660 r in sixty days. Note almost complete resolution of mass.

C. Right lateral chest film before treatment. Note large tumor in anterior-superior mediastinal compartment.

D. Lateral chest film of same patient after treatment. Marked reduction in size of mediastinal tumor.

chogenic carcinoma, particularly when surgery or radiation therapy is contemplated. Steinberg and Dotter (23) have recently reported demonstrable vascular changes in 87 per cent of 100 cases of pulmonary cancer under consideration for surgery. In 43 per cent the vascular evidence indicated inoperability of the lesion and, among these, 17 per cent had early involvement of the superior vena cava system. Clinical evidence of superior vena cava obstruction was often absent in these patients. An-

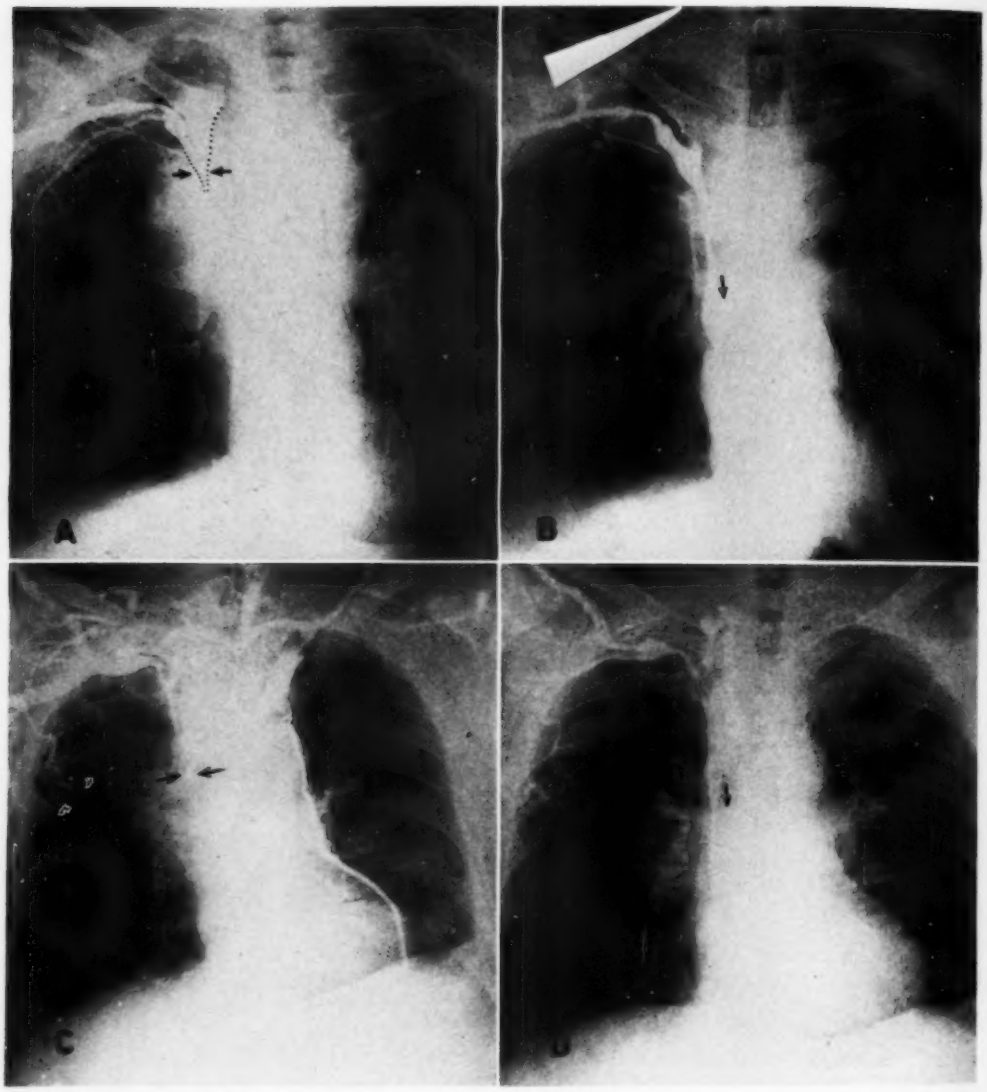

Fig. 7. Illustrative angiocardiograms in 2 patients with the superior vena cava obstruction syndrome prior to and following irradiation, illustrating relief of obstruction and return of blood flow.

A. Angiocardiogram of patient in Fig. 5 prior to treatment. Note almost complete obstruction of the superior vena cava with dilatation of tributaries. Numerous collateral vessels are visualized.

B. Angiocardiogram after treatment, 4,000 r in sixty-nine days. Note improvement of venous return to the right atrium *via* the superior vena cava, which remains somewhat compressed. Note reduction in visualized collateral vessels.

C. Angiocardiogram before treatment in patient seen in Fig. 6. Note obstruction of superior vena cava at a point below the junction of the right and left innominate veins. No opacification of the superior vena cava or the heart. Extensive collateral circulation visualized. Note especially the huge left cardiodiaphragmatic vessel.

D. Angiocardiogram after treatment, 2,660 r. Considerable reduction in visualized collateral channels. Superior vena cava is now opacified.

giocardiography before and after therapy was performed in 8 of our superior vena cava obstruction cases and was always very helpful (Figs. 7 and 8). In the majority of the cases, however, the patient when first seen was in so serious a condi-

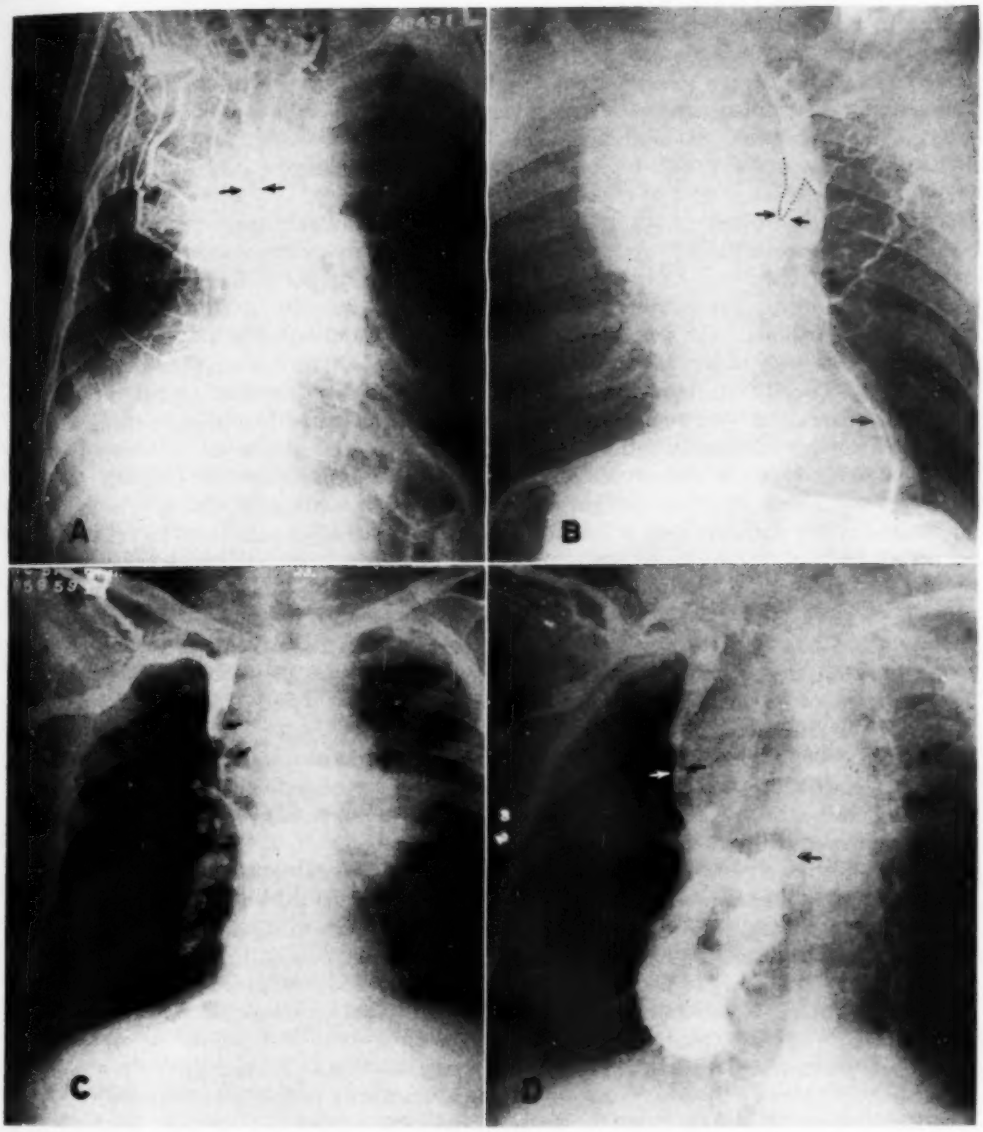


Fig. 8. Illustrative angiocardiograms in 3 patients with superior vena cava obstruction syndrome prior to therapy.

A. H. K. Superior vena cava not opacified, while the azygos vein appears filled and dilated. There is extensive collateral circulation involving principally the internal mammary and lateral thoracic routes. The right pulmonary artery appears obstructed by neoplasm.

B. H. B. C. Note huge mass obstructing the left innominate vein, with failure of opacification of the superior vena cava and the right heart. There is extensive collateral circulation. Venous blood returns to the right heart *via* the inferior vena cava. Note again the huge left cardio-diaphragmatic vessel.

C. T. W. F. Note large mediastinal mass with largest component in the left hilar area. Superior vena cava appears obstructed and non-opacified. Right innominate vein is dilated and carries a filling defect seen medially. The azygos vein is opacified and dilated. Fig. 8D shows amputation of left pulmonary artery by neoplasm.

D. T. W. F. Same patient as in Fig. 8C. Left anterior oblique view clearly demonstrating the obstructive phenomenon previously described. Amputation of left pulmonary artery clearly delineated. The right pulmonary artery is seen on end and is well opacified.

tion as to prohibit the application of even this relatively simple and safe diagnostic procedure. The injected solution should be somewhat more dilute and the volume smaller than for other vascular problems, because of venous stasis and high venous pressure in the vessels of the right upper extremity. Not infrequently, the injection must be made in the left upper extremity (Fig. 8B).

It is of interest that radiographic evidence of regression of the mediastinal tumor was noted in 18 of the 28 patients who responded clinically to treatment. This was often associated with regression of the primary neoplasm and re-aeration of the lung, particularly after roentgen therapy. No roentgen signs of improvement were noted in the 10 patients who failed to respond clinically.

## TECHNIC OF THERAPY

*Roentgen Therapy:* Roentgen radiation was employed in 28 independent courses delivered to 20 patients. Careful localization of the site of obstruction was made on the basis of the collateral venous pattern, conventional radiographs, and Bucky films. Laminagraphy and angiocardiography were also utilized whenever the patient's condition permitted. In most cases, the right anterior-superior mediastinal mass was so large as to permit the use of only one anterior and one posterior portal. The patient was usually treated in the sitting position because the recumbent posture could not generally be tolerated until some degree of decompression was achieved by treatment.

Whenever possible, the hardest quality of x-radiation available in our Clinic was utilized (400 kv., h.v.l. 4.7 mm. Cu). Treatment was given daily and even on week-ends and holidays if the need for decompression was critical. In such cases, the daily tumor dose was 75 to 100 r through a single anterior mediastinal portal. As the patient's condition improved, the daily tumor dose level was gradually raised to 250 r, and this was maintained until maximum clinical benefit was attained. The total tumor dose ranged from 1,000 to 5,000 r delivered through at least two portals. It is our present opinion that a tumor dose of 3,500 to 4,500 r should be approached whenever feasible in order to achieve the longest and most effective remissions.

When transportation to the deep x-ray therapy apparatus was regarded as truly hazardous, a portable superficial machine was sometimes brought directly to the patient's room. At 120 kv., with 3 mm. Al filter, at 30 cm. target-skin distance, one can deliver 50 per cent of the air dose at a depth of 5 cm. As soon as possible, the patient was transferred to the deep therapy apparatus. Because of concern for the skin, even with deep therapy, a grid was utilized in 8 cases and found to be eminently satisfactory. Radiation sickness was encountered only rarely in this series. When it occurred, it was effectively controlled by desoxycorticosterone acetate (6). There were no instances of pulmonary radiation fibrosis or so-called "radiation edema."

*Nitrogen Mustard ($HN_2$) Treatment:* A total of 15 courses of nitrogen mustard—methyl-*bis*(beta-chloroethyl)amine hydrochloride—were delivered to 8 patients. In 4 patients this agent and x-ray therapy were employed concurrently. A course of nitrogen mustard consisted of an intravenous dose administered on each of four consecutive days, employing 0.1 mg. per kilogram of body weight.

This chemotherapeutic agent is a potent systemic toxin and should be administered with caution. To minimize the danger of chemical phlebitis, the injection was made into the rubber tubing of a running infusion. Local extravasation of the drug may result in local tissue necrosis. Sedation will minimize the nausea and/or vomiting encountered in the majority of cases. Damage to the hemopoietic system may be expected but will usually not be as serious as in the treatment of malignant lymphomas. However, marked bone marrow depression prior to therapy contraindicates the use of this agent. The toxic reactions have been described by the authors in de-

TABLE I: RESULTS OF FORTY-SEVEN COURSES OF TREATMENT FOR THE SUPERIOR VENA CAVA OBSTRUCTION SYNDROME IN BRONCHOGENIC CARCINOMA

| Method of Treatment | Number of Courses | Number of Remissions | Number of Failures | Per Cent of Remissions | Remission Periods | | | Average Remission, Weeks | Range of Remission, Weeks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | <1 Mo. | 1–6 Mo. | 6–12 Mo. | | |
| Radiation | 28 | 21 | 7 | 75 | 5 | 10 | 6 | 14 | 1–52 |
| Nitrogen mustard | 15 | 12 | 3 | 80 | 4 | 8 | 0 | 7 | 2–21 |
| Combined* | 4 | 3 | 1 | 75 | 0 | 3 | 0 | 8½ | 8½ |
| TOTAL | 47 | 36 | 11 | 76 | 9 | 21 | 6 | 10 | 1–52 |

* Nitrogen mustard and x-ray given concurrently.

tail in previous communications (19, 20, 21).

Other useful palliative measures must be employed for the control of pain, pulmonary infection, venous thrombosis, respiratory insufficiency, and malnutrition. They were recently discussed in detail by Mayer and Roswit (13). These medical and surgical supportive measures are of real importance in sustaining the patient during the initial critical compression period and for some time after successful decompression with roentgen therapy and nitrogen mustard.

## RESULTS OF THERAPY

Our clinical material consists of 38 patients with the superior vena cava obstruction syndrome in the course of bronchogenic carcinoma, nearly all in the acute phase and seriously or critically ill when treated. All cases were histologically proved, and 90 per cent were of the anaplastic or undifferentiated variety (anaplastic epidermoid, 28; oat-cell, 6; grade 1 epidermoid, 1; alveolar-cell, 1; unclassified, 2). The diagnosis of superior vena cava obstruction was established by means of the clinical picture, venous pressure measurements, angiocardiography, or postmortem examination.

A total of 47 courses of therapy were administered to 38 patients. A satisfactory remission of the superior vena cava obstruction syndrome was achieved in 36 of these courses or 76 per cent. There was an average remission period of ten weeks, with a range of from less than a month to more than a year (Table I).

In 28 *independent* courses of x-ray therapy, a satisfactory response was noted in 21 instances (75 per cent), with an average remission of fourteen weeks. In 5 instances, the radiation response lasted for less than one month, in 10 from one to six months, and in 6 from six to twelve months. In this last group, after a single course of irradiation to the mediastinum, 1 patient was relieved of the superior vena cava obstruction syndrome for one year, 4 others were benefited for eight months, and 1 for seven months. The average tumor dose in this group was 3,600 r. In 15 *independent* mustard courses, remissions were observed in 12 (80 per cent), with an average remission period of seven weeks. In 4 instances, the response lasted for less than a month, and in 8 from one to five months (Table I).

A single *combined* course of irradiation and nitrogen mustard, employed concurrently, was given to each of 4 patients, and in 3 a remission was accomplished lasting an average of eight and a half weeks.

A total of 29 patients (76 per cent) enjoyed a satisfactory response to one or another of the therapeutic agents. Nine patients, or 24 per cent, failed to respond to any single agent or combination of agents. These patients died in less than eight weeks —5 in less than one week. Of a series of 8 untreated cases reported by Rosenbloom (18), all terminated fatally in less than ten weeks after onset of the superior vena cava obstruction syndrome.

Remissions were characterized by relief from intractable respiratory distress, pain, and cough, and abatement of cervicofacial edema and cyanosis, often within twenty-four to forty-eight hours. Headache, ver-

tigo, and syncope regressed, and many patients gained strength, weight, and appetite. Several were returned to their homes and to normal activity for many weeks and even months.

Objective evidence of improvement, both clinical and radiologic, was noted in more than two-thirds of the patients who responded well subjectively. The large masses in the right anterior-superior mediastinum were seen to regress and occasionally, in irradiated patients, failed to reappear locally during the lifetime of the patient. When the primary bronchial lesion happened to fall within the mediastinal treatment portals, there was often roentgen evidence of shrinkage of the lesion, with re-aeration of the pulmonary fields. When nitrogen mustard was used, temporary systemic improvement was particularly prompt, characterized by subsidence of malaise, weakness, anorexia, night sweats, etc. After the initial discomfort of nausea and vomiting engendered by the drug, the patients soon gained weight, strength, and appetite.

We have not sufficient data (only 4 cases) to evaluate the *combined* use of nitrogen mustard and x-ray therapy. However, there is no clear evidence from any source to support the superiority of the combined technic as compared with either agent alone.

All of the patients but one are now dead as a result of their malignant disease. We have no evidence that the *average* survival time was increased by treatment. We are convinced, however, that when the majority of the cases are individually considered, the period of comfort and useful life was appreciably prolonged. Many were grateful for even a brief respite from the insufferable distress of superior vena cava obstruction.

## DISCUSSION

The rapidly increasing and significant number of patients with inoperable bronchogenic carcinoma makes it mandatory that effective palliative measures be applied for the relief of distressing major complications and prolongation of useful activity during the downhill course of the disease. Our own experience with roentgen therapy in 600 cases, supported by 508 cases reported in the literature (3, 12, 25, 26) indicates clearly and convincingly that this can be best accomplished by radiation therapy (3, 12, 20, 21, 25, 26), with nitrogen mustard as a useful adjunct (12, 23, 24). Particularly is this true of the superior vena cava obstruction syndrome, when patients are in desperate need of decompression though use of these effective therapeutic agents. Our own experience and that of others (18) suggest that without treatment, or after ineffective treatment, these individuals will rarely survive for more than ten weeks, and often less than one week if the expansion of the neoplasm is particularly rapid. Roentgen therapy achieved a striking degree of palliation in 76 per cent of our treated cases, with an average remission period of fourteen weeks. The remissions in patients receiving nitrogen mustard averaged seven weeks (Table I). In 6 of the 21 individuals who were benefited by irradiation, the remission period lasted from six months to a year, while benefit from nitrogen mustard lasted no longer than five months in any case. The beneficial results of roentgen therapy were far more striking, more objective in character, and longer lasting than those obtained with nitrogen mustard.

In patients with the superior vena cava obstruction syndrome, the pressing problem is local, and it would seem reasonable to employ the most effective and least toxic local therapeutic agent. Local application of roentgen rays can cause far more lasting injury to tumor cells than the systemic use of nitrogen mustard (10, 20). We believe that irradiation in these cases is without real hazard except in rare instances. We have not ourselves observed a single example of so-called "radiation edema" in the mediastinal area. Nor have we encountered radiation sickness except in isolated cases, and in these it has not constituted an obstacle to completion of roentgen therapy.

In our opinion, therefore, x-ray therapy, whenever feasible, should be the treatment of choice in patients with the superior vena cava obstruction syndrome. Nitrogen mustard should be administered only at those intervals when roentgen therapy is truly unfeasible or ineffective. When utilized in this role, this drug becomes a valuable adjunct in the therapeutic management of the syndrome.

As angiocardiography becomes more widely applied in patients with bronchogenic carcinoma, superior vena cava obstruction will be discovered at an earlier stage (23). Such patients should be spared the discomfort of thoracotomy and be promptly referred to the therapeutic radiologist for early treatment.

## SUMMARY AND CONCLUSIONS

1. Obstruction of the superior vena cava in the natural history of bronchogenic carcinoma is a frequent and ominous complication attended by severe discomfort and disability.

2. In a clinical study of 38 such cases, roentgen therapy and nitrogen mustard were found to provide a striking degree of palliation of the superior vena cava syndrome and prolongation of useful activity in 76 per cent of the patients.

3. In our opinion, roentgen therapy is the treatment of choice, with nitrogen mustard as an adjunct at those intervals in the course of the disease when irradiation is unfeasible or ineffective.

4. It was of particular interest that in most of the patients the lesion originated in the right upper lobe and was of an anaplastic nature, with a rapid growth potential.

5. In the light of this experience, we have discussed in detail the pathologic physiology, clinical picture, radiographic features, and the therapeutic management of this important complication.

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SUMARIO

**El Síndrome de Obstrucción de la Vena Cava Superior en el Carcinoma Broncógeno: Fisiología Patológica y Asistencia Terapéutica**

La oclusión de la vena cava superior constituye una complicación frecuente y ominosa del carcinoma broncógeno, yendo acompañada de intensa incomodidad e incapacidad. Fué observada en 15 por ciento de una serie de casos asistidos por los AA. Nótase más a menudo en las lesiones que tienen su origen en los bronquios del lado derecho y se asocia casi siempre con neoplasias de la variedad anaplásica dotadas de inusitado potencial de desarrollo. La interrupción del paso de la sangre en la vena cava puede deberse al tumor bronquial primario o a los ganglios linfáticos afectados, principalmente a consecuencia de la compresión externa, a veces a invasión intraluminal y raramente a verdadera trombosis. El grado de la incapacidad y el pronóstico inmediato dependen de la eficacia de la circulación colateral. Para averiguar esto, a la par que para la determinación del tamaño y de la naturaleza de la oclusión, la flebografía o la angiocardiografía son las más útiles.

En lo observado por los AA., la roentgenoterapia y/o la mostaza nitrogenada han aportado en forma notable paliación y prolongación de la actividad útil en esos casos. Considérase que la irradiación es el tratamiento de elección, con la mostaza nitrogenada como coadyuvante en los períodos de la evolución de la dolencia en que la roentgenoterapia resulta ineficaz o no es factible.

DISCUSSION

**Jesshill Love, M.D.** (Louisville, Ky.): I am sure you have appreciated the valuable information Dr. Roswit has developed in his paper. The superior vena cava obstruction syndrome is not a new subject with him. He has investigated the condition thoroughly and has written specifically of it and presented comprehensive exhibits of the etiology, physiology, and therapeutic management. This dissertation is a timely one to direct our further attention to an important entity and definite syndrome occurring in the natural progress of bronchogenic carcinoma and to the possibility of definite palliation for this group of neglected patients.

The effect of nitrogen mustard on lung cancer is due possibly to the relatively large doses delivered primarily to either lung immediately after intravenous injection. As you all know, nitrogen mustard has an extremely short half-life and must be delivered quickly. The volume of the material reaches the tumor directly, in either lung, through a physiological routing by way of the blood stream. The technic and method of therapy have been so well detailed that further comment is unnecessary.

In the face of a well presented subject, I often turn to my own neighborhood problems to find application for newer ideas. The diagnosis of the superior vena cava obstruction syndrome and its management could well be applied. The Vital Statistics of Kentucky for 1951 showed 3,363 total cancer deaths, 111.8 per 100,000. Of this number, 295 were from lung cancer, which was outranked only by gastrointestinal cancer. The distribution of lung cancer by age, sex, and race follows the usual reported figures. Thus, we have an alarming problem—50 to 60 expected cases of superior vena cava obstruction per year.

In our Department of Radiotherapy, 46 patients were seen and treated for bronchogenic

carcinoma in the past four years. All of these were considered to have inoperable or terminal disease and were accepted for palliation. Twelve were recorded as showing dyspnea, acute pain, and orthopnea, and 3 had increased venous collaterals on the chest wall. None were tagged with the superior vena cava obstruction syndrome. Benefit was obtained in 60 per cent of the patients, but none survived eight months. All received combined nitrogen-mustard and roentgen therapy (400 kv., 4.5 Cu h.v.l.) except 2 who were submitted only to massive "grid" therapy (250 kv., 1.1 mm. Cu h.v.l.).

Several other patients were treated by the Chest Service by nitrogen mustard alone, with relief of dyspnea. We usually administered more than the recommended 0.1 mg. per kilogram for four days, but never more than 10 mg. per dose.

The pathology of this tumor is worthy of a brief review to follow Dr. Roswit's description of the pathologic physiology. Remarkably enough, the name bronchogenic carcinoma specifically implies an epidermoid (squamous-cell) tumor arising from the surface epithelium of the bronchi. Gradual transition from the normal columnar epithelium, presumably by metaplasia, through atypical squamous elements, into areas of "carcinoma *in situ*" and frank invading carcinoma has been demonstrated in single large sections. The break-through or invasion through the wall of the bronchi and transitions of atypical squamous collections have been cited as proof of multicentric origins in related areas of the same bronchi. The bulk of the tumor necessarily forms outside of the parent bronchi, and the avenue of invasion follows the line of the least resistance, usually toward the hilus. Re-invasion of the neighboring bronchi accounts for the massive roentgenologic findings of atelectasis and consolidation which are secondary to tumor producing intrinsic and extrinsic bronchial obstruction. The lymph nodes in juxtaposition are invaded and seeded. Metastases carry the epidermoid element. Primary tumors near the hilus may soon gain entrance into the mediastinum and produce the bulk of the mass by unobstructed growth invading the adventitia of the great vessels. The progress of the symptoms lags considerably in comparison to the growth pattern. It is easy to understand why a majority of patients present themselves with advanced disease when one reviews the pathology producing the early signs.

In closing, may I again remind you that this is a plea to offer palliation to this group of patients.

# The Irradiation Management of Primary Round-Cell Tumors of Bone

JOHN H. WALKER, M.D., and HUGH W. JONES, M.D.[1]

RECENT APPRAISAL of the results of irradiation therapy in a group of bone tumors treated at The Mason Clinic (Seattle, Wash.) has made it apparent that the proportion of survivals in patients having Ewing's tumor is high compared with larger, well documented series (11, 12). The original diagnosis of Ewing's tumor was established in our series upon the basis of clinical history and radiographic evidence, and was confirmed by adequate biopsy. With renewed interest, blocks of tumor tissue were recut and made available for examination by several reputable pathologists.[2] Four of the cases in the series which were thought at one time to represent Ewing's tumor were reclassified. In 3 of these the final accepted diagnosis is reticulum-cell sarcoma, and in 1 solitary myeloma.

With this background in mind, we present our experiences and conclusions in regard to the management of round-cell tumors of bone. It appears significant that:

1. Where round-cell tumors have been critically re-evaluated, Ewing's sarcoma has frequently been shown to be an erroneous diagnosis.

2. Primary reticulum-cell sarcoma of bone is seldom listed in large series as an entity though, when it is recognized, the prognosis has been uniformly good. This tumor deserves particular attention as a malignant, non-osteogenic round-cell tumor of bone which, even though involving multiple bones and anatomically inoperable, should receive aggressive rather than palliative irradiation.

3. Myelomas occurring as solitary tumors may closely resemble Ewing's tumor histologically. This has been pointed out by Johnson (9). These lesions are amenable to intensive irradiation.

It is particularly noteworthy that a substantial percentage of final diagnoses of round-cell tumors are made in hindsight. Our experience is not unique. Jackson and Parker (8), reporting 25 cases of reticulum-cell sarcoma primary in bone, found 13 which had been previously classified as Ewing's sarcoma in the Bone Registry of the American College of Surgeons. In a collection of 37 cases of primary reticulum-cell sarcoma of bone, Coley *et al.* (4) found that 7 were originally interpreted as Ewing's sarcoma. Prevo (13) lists 55 cases of Ewing's tumor in an analysis of 205 cases of malignant primary bone tumor but makes no mention of reticulum-cell sarcoma. Rosh (14), in a report of 121 treated cases, also omits any reference to reticulum-cell sarcoma. The entity of reticulum-cell sarcoma, although well established in 1939, is seldom mentioned in orthopedic literature. A review of the papers in the *Journal of Bone and Joint Surgery* over the past ten years fails to uncover even the mention of reticulum-cell sarcoma except in an obscure abstract which includes it in a discussion of the differential diagnosis of Ewing's tumor.

The urgent primary consideration in evaluating lesions of bone is the segregation of bone tumors from non-neoplastic processes. Clinical symptomatology is usually the first link in establishing a specific diagnosis. Symptoms of bone tumors are not specific. The presenting complaint of pain, accompanied by fever and localized swelling, may be present in either bone tumor or osteomyelitis. The physician confronted with this triad may erroneously arrive at

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[2] We express appreciation to Fred W. Stewart, M.D., Memorial Center, New York, and to Lent C. Johnson, M.D., and Brig. Gen. Elbert DeCoursey of the Armed Forces Institute of Pathology, for their review of our material and their constructive comments.

the latter diagnosis. Undue delay may result while trials of antibiotic therapy are conducted.

Radiologists will recognize the pitfalls in radiographic diagnosis of bone tumors and these difficulties need not be reemphasized at this time. No clear-cut diagnostic differentiation is possible as to the cell type of any particular osteolytic tumor of bone by radiographic means. Broad generalizations can be made as to the characteristics of certain tumors (15), but such generalizations may not be valid when applied to a single case.

The response of a tumor to irradiation as a diagnostic test is to be condemned. Once irradiation has been initiated, irreversible changes occur in the tumor, adding further confusion to a situation already complex to the pathologist. It is noted with amazement that the so-called "therapeutic trial" of irradiation is still employed by many, and is even advocated as a substitute for biopsy (7, 14). The diagnosis of round-cell tumor of bone cannot be made on the basis of clinical symptoms or roentgenologic findings alone, and most certainly not on the basis of the so-called "therapeutic trial." Specific diagnosis must rest upon adequate histopathological examination.

We are at complete odds with Brailsford's attitude toward biopsy. As recently as 1948, in an editorial in RADIOLOGY, Brailsford (1) wrote: "No matter which method is used [referring to biopsy], it is unreliable; has resulted in delay in establishing the correct diagnosis, and in the destruction of limbs with lesions which, left alone, would have resolved. . . ." Yet, earlier (2) he had stated: "When the lesion is malignant, according to radiological examination, and apparently operable, amputation should be performed as early as possible. . . ." This latter attitude is treacherous indeed.

In our experience, biopsy offers no hazard to the patient's well-being or danger of dispersal of tumor beyond its confines. In each case illustrated here, treatment was instituted only after study of permanent sections obtained following open biopsy. Reliance was not placed upon frozen section. Each tumor which we include in the round-cell grouping has recognizable and well documented differential histologic characteristics when examined critically and under favorable conditions (*i.e.*, no previous irradiation and adequate material properly preserved). We recognize the hazard in establishing a definite histologic diagnosis in primary non-osteogenic bone tumors and have deliberately chosen the term round-cell tumor as a "working diagnosis" for our immediate guidance and future management with the least procrastination. Not infrequently, only generalizations and working diagnosis of "round-cell tumor" can be made from partially necrotic tissue from a rapidly growing tumor. It should be emphasized that consulation with a pathologist, a radiologist, and a surgeon is invaluable at the time of biopsy in an effort to obtain representative sections from the tumor site.

An attitude of pessimism has long veiled the management of bone tumors, no matter whether the treatment be by irradiation, surgery, or a combination of both. This has been especially true of inaccessible lesions such as those involving the spine. The outlook has been considered hopeless by some observers when regional lymph nodes beyond the site of the tumor have been involved. In the presence of a primary round-cell tumor, curative rather than palliative efforts should be undertaken, even when more than one bone is involved. Despite relatively homeopathic doses of irradiation, long remissions and apparent cures have been reported in isolated cases. This is true both of reticulum-cell sarcoma (10) and the condition known as solitary myeloma. It is of interest to note that in two of the cases reported by Coley *et al.* (4) in which recurrence developed after ten years, a small tumor dose was employed according to present-day standards. It seems probable that five-year survivals will be reported more frequently by those subscribing to intensive judicious

external irradiation (see Cases III, IV, and V).

The general consensus, as represented by the larger treatment centers throughout the country, is that Ewing's tumor should first receive preoperative irradiation, followed by surgical amputation well above the lesion and postoperative irradiation if lymph node involvement unsuspected prior to surgery is discovered at operation.

The five-year survival for Ewing's tumor varies from zero in the experience of some (11) to 19 per cent in others (6). Lichtenstein attributes this discrepancy to improper identification of tumors. McCormack (12) reports that the variation between those treated by surgery and irradiation is so slight that it is not statistically significant. He raises the question: "Are the one-legged deaths worth the one-legged cures?" Since the reported long survivals are not significantly greater by one method of treatment as compared to another—that is, surgery *vs.* irradiation—should we not reappraise this whole subject? We are convinced that many so-called "cures" in Ewing's tumor by either method of treatment are actually cures of reticulum-cell sarcoma and other relate tdumors. Such being the case, could not those patients having had radical amputation perhaps have survived without the consequent morbidity incurred by the operative procedure?

The results of those reporting on series of reticulum-cell sarcoma sufficiently large to be statistically significant indicate without doubt that the treatment of choice is irradiation. Sufficient evidence is not at hand to support the concept that amputation, either alone or in conjunction with irradiation, offers a greater chance of survival.

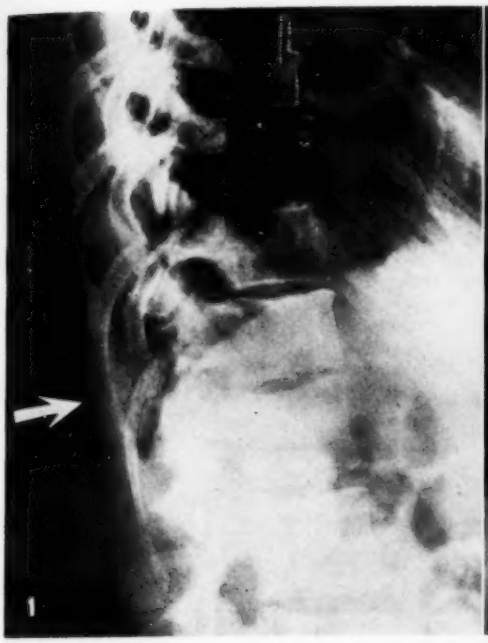
Empirical formulae cannot be adopted or set forth for the irradiation management of malignant lesions of bone of the round-cell group. There are, nevertheless, customary precepts of conservative irradiation that should be followed. When the primary site of the tumor is in an extremity, the entire bone should be subject to irradiation. This should include an area well below the distal and above the proximal joint. Irradiation may be directed through opposing fields on alternating days, covering the entire portion of the extremity under consideration. If certain tumors prove to be unusually radiosensitive, the maximum tolerated dose of radiation should be administered despite an unexpected favorable response. When one is faced with the apparently insurmountable odds of a large tumor of an extremity, and obviously involved regional lymph nodes, it is easy to fall into the trap of palliation. Case II illustrates nicely that intensive therapy carried out over a prolonged period of time may produce an unexpected salvage. Lower extremity lesions complicated by involved inguinal nodes have, it must be assumed, similarly invaded the deep pelvic and pre-aortic nodes. A course of therapy to include these areas must therefore be instituted.

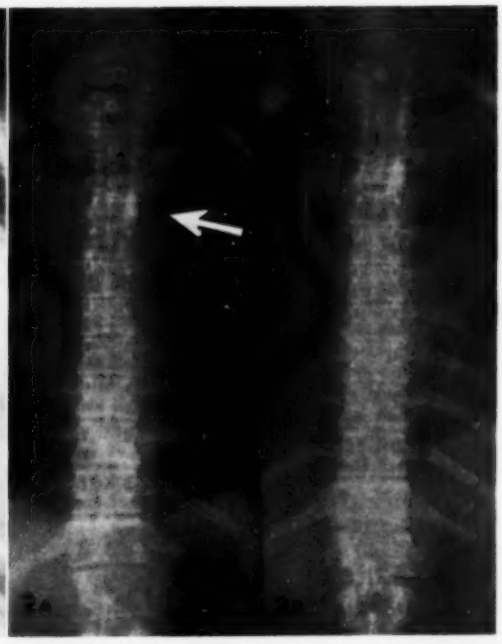
When the primary tumor involves more than one bone, as in our Case I, equal attention should be devoted to each lesion. It is the routine practice in our department to check the adequacy of fields by suitable markers and follow-up roentgenograms. It is unnecessary to emphasize that the irradiation fields, or summation of the fields, should completely and widely encompass the lesion under treatment.

## CASE SUMMARIES

CASE I: Mrs. M. H. L., a 35-year-old housewife, was first seen on March 26, 1947, with back pain of six months duration. Her present difficulty began in September 1946, with sudden onset of pain in the upper back, between the shoulder blades. Since that time she had never been completely free from pain, although it migrated at intervals between the upper dorsal and lumbodorsal areas. In November 1946, an area of swelling developed over the upper dorsal spine, subsiding after several weeks. In January, a similar area appeared over the lumbodorsal spine. This partially subsided but again recurred.

On examination, an area of tumefaction was found over the lower dorsal spine, measuring 4 × 3 cm. This was firm and tender. Considerable limitation of motion in all planes was present. Neurologic findings were not significant except for

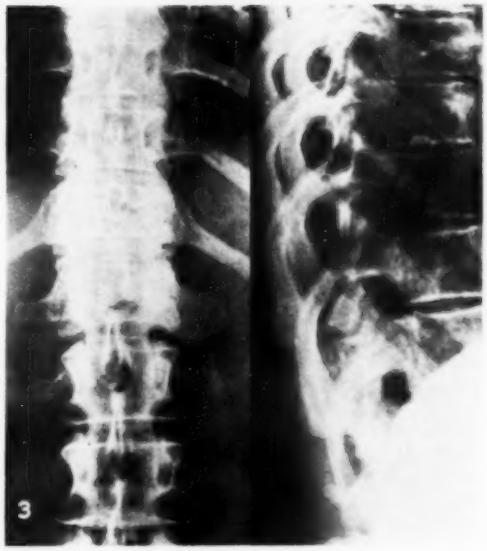




Figs. 1–3. Case I. In Fig. 1, note the complete destruction of the spinous process of the 12th thoracic vertebra.

Fig. 2A shows the complete loss of the architecture of the 1st lumbar left transverse process and the compression of the 4th thoracic body. The pedicle of the 4th thoracic body is also destroyed. The pedicle of L-1 is lost, as well as the spinous process, as is seen on this anteroposterior projection. Fig. 2B illustrates the re-ossification of the first lumbar transverse process, pedicle, and spinous process one year later.

Fig. 3. Five years post-irradiation. Note the complete re-ossification of the transverse process of L-1 and partial regeneration of the spinous process of T-12. The pedicle also shows regeneration.



slight diminution of the left biceps reflex and an equivocal sensory loss on the inner aspect of the left arm. Blood and urine studies were normal. The corrected sedimentation rate was 39. The serology was negative, as were agglutination tests for typhoid, paratyphoid, and brucellosis. All other laboratory tests, including A/G ratio determinations, alkaline phosphatase, and stool examinations were within normal limits. The Mantoux test was negative with second strength PPD.

Roentgenograms of the spine demonstrated diminution of the intervertebral joint space between T-12 and L-1. The spinous process of T-12 was completely destroyed (Fig. 1), and only a faint outline of the left transverse process of L-1 remained. Destruction was present in the pedicles of T-12 and the pedicle on the left side of L-1, and the laminae and apophyseal joints of T-12. The body of T-4 was collapsed, and destruction was noted in the pedicle of this segment (Fig. 2A). A general bone survey revealed no other osseous involvement. A biopsy was taken under local anesthesia from the soft-tissue tumescence overlying the 12th dorsal vertebra. The report rendered from the fixed sections was Ewing's sarcoma. X-ray therapy was instituted at the rate of 200 r per day (in air) to each lesion.

After the initiation of irradiation, pain relief was conspicuous. Within the next several months the

areas previously showing destruction filled in with bone of abnormal contour but of good trabecular pattern, especially in the transverse process of the 1st lumbar vertebra (Figs. 2B and 3). Since that time the patient has been completely asymptomatic. Six years have passed since the onset of symptoms and over five years since the beginning of treatment. The tumor dose in each instance was in excess of 3,500 r.

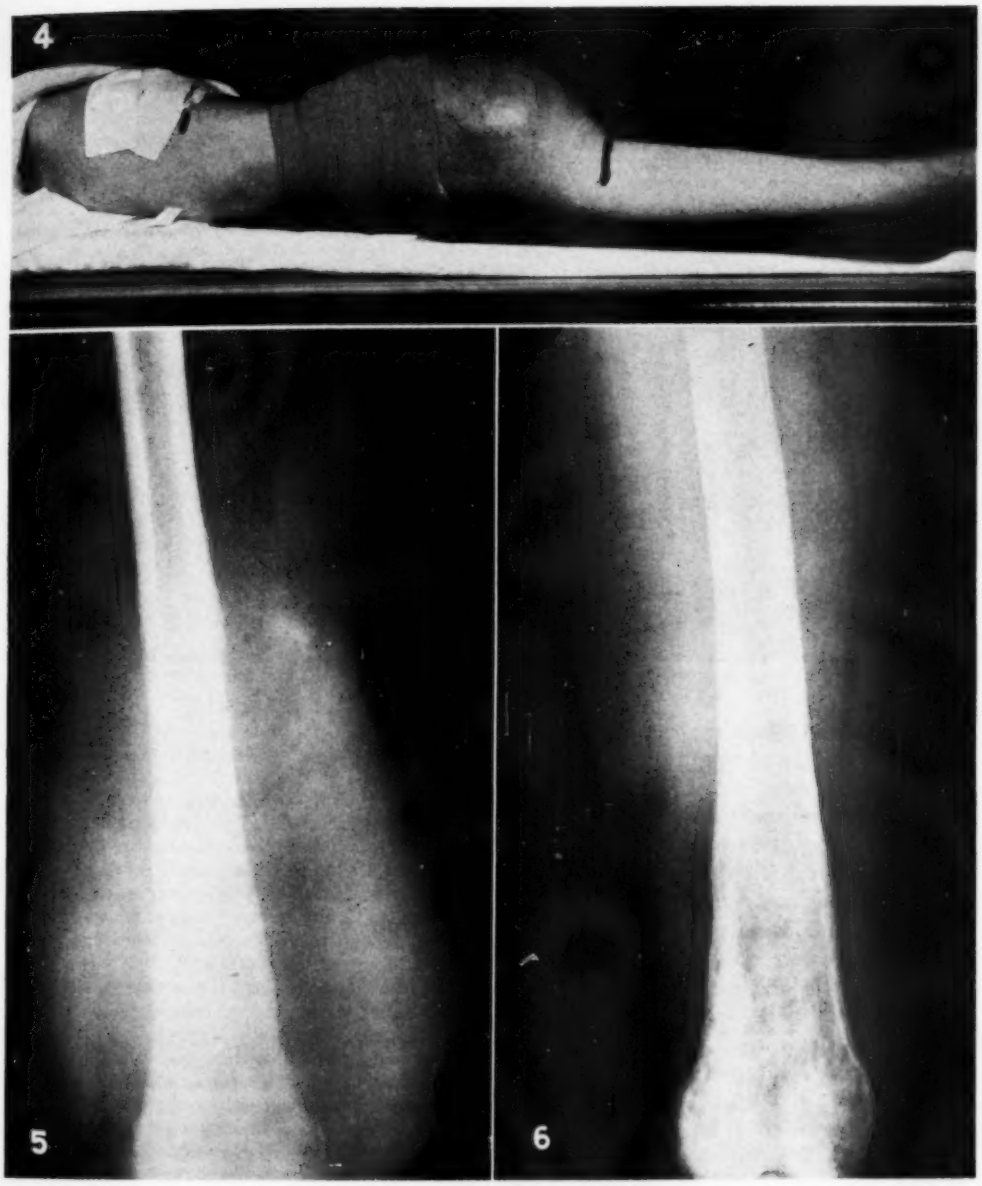
*Comment:* This case is of particular interest in that it was originally diagnosed as Ewing's sarcoma. Its response was typical of Ewing's tumor, and the multiplicity of lesions in the spine was also rather characteristic of that disease. The case has since been reviewed by a number of authoritative pathologists, who are in general agreement that it represents a reticulum-cell sarcoma. Nowhere in the literature have we found a report of a similar tumor having multiple foci with a five-year survival in apparent health.

CASE II: D. F. B., a 23-year-old, unmarried office worker, in October 1947 noticed a painful swelling above the right knee. The swelling increased rapidly, accompanied by a weight loss of 50 lb. and general cachexia. When the patient was first seen, in January 1948, a tremendous fusiform tumor involved the distal half of the right thigh (Fig. 4). This tumor measured 19 cm. in diameter, both in the anteroposterior and lateral projections. It was extremely tender to touch. Inguinal nodes were grossly enlarged. Radiographic examination indicated that the tumor was primary in bone. There was no attempt at osteogenic activity (Fig. 5). An orthopedic surgeon obtained biopsy material, both from the main tumor and from the involved inguinal nodes. The report from fixed sections was Ewing's sarcoma. Irradiation was then instituted.

Nine ports were outlined, including the entire right femur from several inches below the knee to well above the inguinal area, covering the right lower quadrant. A dose of 300 r per day, as measured in air, was administered through 20 × 30-cm. ports. Two ports were treated each day. The fact that large ports were used, with relatively high dosage, increased the irradiation intensity factor. As might be expected, the decrease in size of the tumor and relief of pain were dramatic. The patient's well-being was manifest in ratio to the rapid disappearance of the tumor mass. After treatment to the lower extremity was completed, she was allowed to return home for a period of two weeks, with the provision that she return for further irradiation. Opposing 10 × 20-cm. lower abdominal fields were then irradiated. These portals covered the lower presacral and pre-aortic chain. Radiation was first administered at the rate of 250 r per day, alternating between anterior and posterior ports. This later was increased to 300 r per day. A total of 3,100 r measured in air was given to each port. Follow-up roentgenograms showed deposition of calcium within the tumor itself; this, however, was gradually resorbed during the next year. A definite increase in overall texture and density of the bone was the end-result. Multiple small areas of bone rarefaction still remained in the follow-up films, and have shown no change from year to year (Fig. 6). The patient has returned to full activity as an office secretary and has since married. The only restriction of her activities is discontinuation of roller skating, a previous recreation. The lower extremity now shows brawny induration and telangiectasia of the skin, but there is no restriction of motion.

*Comment:* This case illustrates a remarkable response to irradiation in a seemingly hopeless situation. It lends emphasis to the precept calling for treatment above and below the lesion, and indicates especially the importance of intensive irradiation of the regional nodes as well as more distant nodes. This tumor, which had all the clinical and radiographic characteristics of Ewing's sarcoma, has since been reviewed, and general agreement is that it is a reticulum-cell sarcoma. The patient has survived five years since the onset of her disease and almost five years since the initiation of therapy.

CASE III: A. C., a 55-year-old Syrian elevator operator, stated that he was well except for slight discomfort in the left shoulder girdle, especially after a day's work, which he attributed to closing the heavy elevator door in a forty-story building. In a mass roentgenologic chest survey, a tumor completely replacing the left 1st rib had been discovered. The entire rib was destroyed, but the tumor was fairly well outlined on the roentgenogram (Fig. 7). The proximal half of the left clavicle was removed at the time of surgical approach in an effort to resect the rib and tumor mass. It was the opinion of the surgeon that resection was not feasible for obtaining a cure, and the patient was therefore referred to the Department of Radiology for further management. Large opposing anterior and posterior ports, entirely encompassing the lesion and a sufficient portion of normal surrounding tissue, were employed. The calculated tumor dosage was 3,820 r, administered at the rate of 200 r per day. Response to irradiation was good. An extremely intense epidermite developed with resultant telangiectasia and

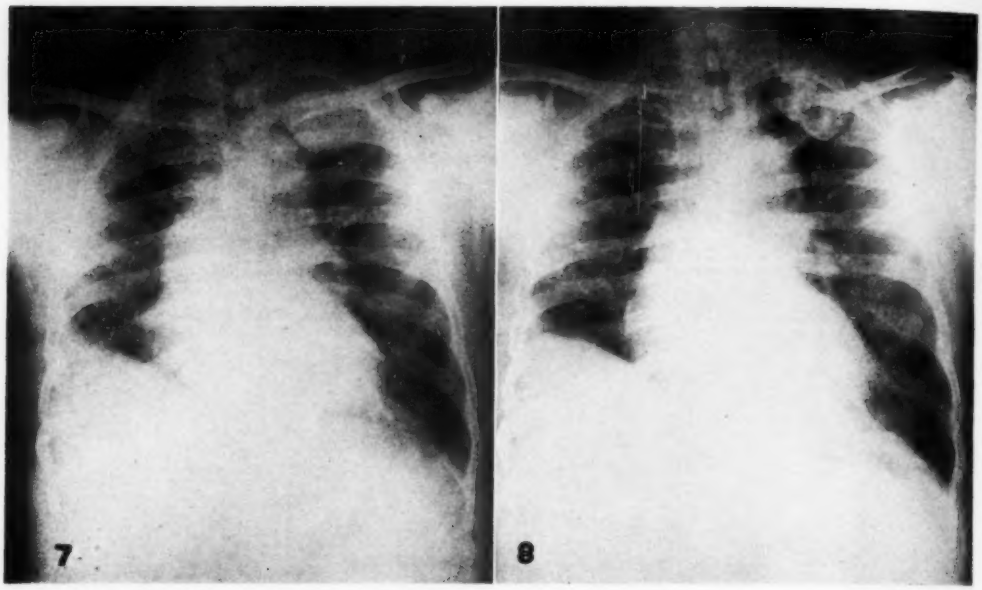



Figs. 4–6. Case II. Fig. 4 shows the tremendous fusiform tumor involving the distal half of the right thigh. In Fig. 5 the actual destruction within the distal femoral shaft is partially obscured by the overlying tumefaction within the soft tissue. No attempt at osteogenic activity is present in the soft tissues. Some periosteal response is noted in several areas.

Fig. 6 shows multiple small areas of bone rarefaction remaining five years after completion of treatment, with no change from year to year. A definite increase in overall texture and density of bone is the end-result.

permanent atrophy of the skin. Five years have elapsed without recurrence.

*Comment:* This case is of special interest in that the lesion had not caused sufficient symptoms for the patient to seek medical investigation. It was uncovered incident-




Figs. 7 and 8. Case III. Fig. 7. Tumor completely replacing the left 1st rib discovered in a mass chest x-ray survey.

Fig. 8. The lesion involving the 1st rib has completely filled in with bone and cartilage. The end-result is a grossly distorted rib resembling an osteochondroma. Final diagnosis: Reticulum-cell sarcoma.

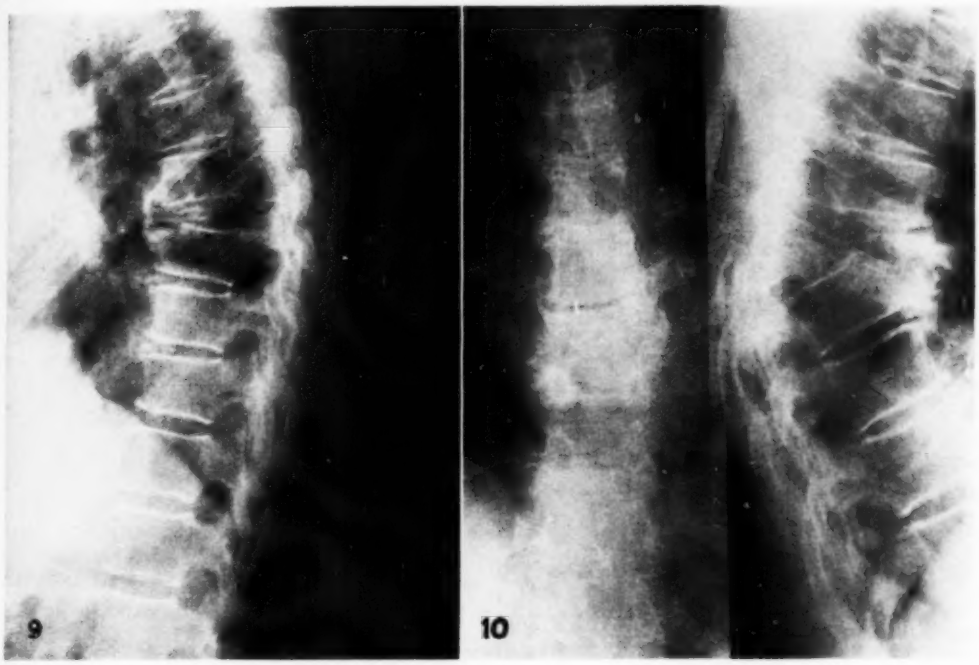
ally as a result of a mass chest survey. Originally diagnosed as a Ewing's sarcoma, the lesion has completely filled in with bone in a grossly distorted rib, but has a definitely benign appearance at this time (Fig. 8). The patient is well. He has no complaints and has returned to full occupation as an elevator operator. The partial resection of the left clavicle has caused him no disability. The consensus after a review of permanent sections is reticulum-cell sarcoma.

CASE IV: Mrs. R. A. H., a 57-year-old white female, stated that in the early 1930's she suffered a fracture of the spine in an automobile accident but recovered uneventfully. One year later she injured her back in a fall, and recovery was again satisfactory. A third injury, in 1946, responded favorably to two weeks of bed rest. Two months before examination there was a recurrence of backache, radiating to the lower ribs. In addition, there was progressive difficulty in locomotion, to the point of complete inability to walk, with marked impairment of voluntary movements of the legs. Paraplegia developed rapidly. Radiographic examination showed complete collapse, both anteriorly and posteriorly, of the 8th dorsal body (Fig. 9). Lumbar puncture indicated a spinal fluid block, with increased protein in the fluid. Wassermann and colloidal gold tests on both spinal fluid and blood were negative.

A laminectomy with decompression was done on Jan. 15, 1948, revealing anterior extension of an extradural mass which invaded the entire pedicle of the 8th dorsal vertebra, especially on the right side. As much of the tumor was removed as was possible. Six days following surgery, irradiation was initiated through adequate fields to cover the lesion.

A calculated tumor dose of 2,750 r was administered in a relatively short time at the rate of 300 r, as measured in air, per day. Roentgen examination at the time of initiation of therapy showed a definite soft-tissue tumefaction posteriorly over the involved 8th dorsal body. This tumor could be seen as a fusiform mass on the postero-anterior view of the chest. Subsequently, over the next two years, the 8th dorsal vertebra became completely fused to the body immediately below. There has now occurred a sharp kyphotic knuckle with firm fusion, as seen in the lateral projection (Fig. 10). The fusiform soft-tissue mass has disappeared completely.

Gradually, over the three months following surgery, the patient regained her strength and, although reluctant to walk, was finally discharged, walking alone and unaided but with the help of a cane. Since that time she has taken care of herself. She lives alone and is able to do complete household work. She has minor radicular pain associated with the segment of involvement.



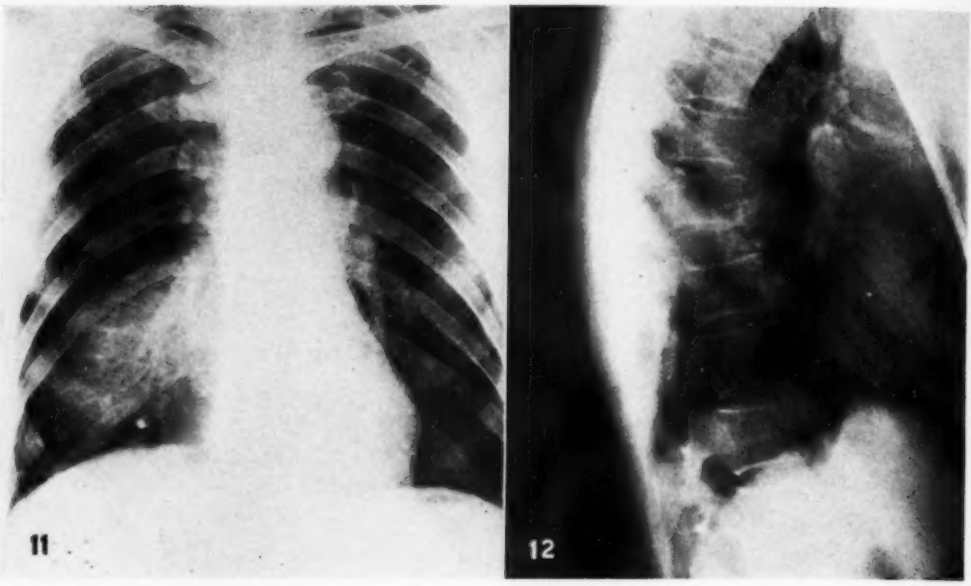

Figs. 9 and 10. Case IV. Fig. 9. Solitary myeloma involving the 8th dorsal body, with complete destruction of all bone except the superior and inferior vertebral plates.
Fig. 10. Prominent kyphotic knuckle which developed over a four-year period following completion of x-ray therapy. Note also the regenerated spinous process.

*Comment:* This tumor was originally diagnosed as a round-cell sarcoma, type undetermined. Subsequent studies have indicated that it is a solitary myeloma. Although, in retrospect, the therapy administered was perhaps not as intensive as might have been given, it was apparently sufficient to cause a five-year remission without evidence of active disease.

CASE V: P. Y. W., a 61-year-old white male, was hospitalized on July 12, 1948, following recurrent back pain of two years duration, which had increased in severity during the past year. The pain was non-radiating and was aggravated by coughing and sneezing. Three months prior to admission the patient became completely bedridden because of severe pain and some swelling over the lower dorsal spine, extending toward the right side at the level of the 9th rib. Systemic review was negative. The radiographic examination showed destruction of the 9th rib on the right side posteriorly, extending into and contiguous with destruction of the 9th dorsal vertebra (Figs. 11 and 12). The referring physician had reported Bence-Jones protein in the urine on several occasions.

A biopsy of the 9th rib was taken on the day following hospital admission and was reported as either myeloma or Ewing's sarcoma. The lesions, which actually involved two bones, but in direct continuity with each other, were treated through a single posterior field. The patient was extremely ill, and narcotics were required each day prior to his transfer to the Department of Radiology. Pain relief following the beginning of irradiation was somewhat slower than in the other cases. A total of 4,305 r at the skin, including back-scatter, was given at the rate of 200 r per day. The calculated tumor dose was approximately 2,400 r to the involved vertebra, and considerably higher in the rib. Following completion of treatment, the patient gained rapidly, was able to resume activity in his own laundry, and now carries on a full day's work.

*Comment:* Final diagnosis in this case was solitary myeloma. Although the tumor dose was not high, the patient has done well and is now in his fifth year of survival, following beginning of treatment. Of particular interest is the reversal of the Bence-Jones protein in the urine. Since the patient lives in Alaska, labora-




Figs. 11 and 12. Case V. Solitary myeloma. Fig. 11 shows extensive destruction of the right 9th rib, with associated involvement of the 9th thoracic vertebral body.
Fig. 12 shows complete destruction of the 9th thoracic vertebral body from solitary myeloma.

tory studies must be carried out there. His referring physician has not been able to detect the presence of Bence-Jones protein since his return there some four years ago.

## SUMMARY

Accurate classification of Ewing's sarcoma, reticulum-cell sarcoma, and solitary myeloma may at times be impossible. This problem is being recognized with increasing frequency by those reviewing large series of bone tumors. Errors in diagnosis may result in the rendering of a relatively hopeless prognosis with attendant lack of aggressive therapeutic management. The "working diagnosis" of round-cell tumor of bone in doubtful cases allows for an open mind in the prognosis and the application of therapeutic procedures. Irradiation is the preferred treatment in most instances because of the preservation of useful extremities in some and the inaccessibility to surgical approach in others. Several illustrative cases are presented of unanticipated long-term survivals following irradiation.

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SUMARIO

**El Manejo de la Irradiación de los Tumores Globocelulares Primarios del Hueso**

A veces puede resultar imposible la clasificación exacta del sarcoma de Ewing, del sarcoma retículocelular y del mieloma solitario. Este problema va siendo reconocido cada vez más por los que repasan grandes series de tumores óseos. Los errores de diagnóstico pueden dar por resultado la formulación de un pronóstico relativamente desesperado con la consiguiente falta de enérgica asistencia terapéutica. El "diagnóstico tentativo" de tumor óseo de células redondas permite mantener imparcialidad en el pronóstico y la aplicación de procedimientos terapéuticos. En la mayor parte de los casos, la irradiación es el tratamiento preferido, debido a que conserva miembros útiles en algunos enfermos y a ser inaplicable el ataque quirúrgico en otros. Preséntanse típicos casos de sobrevivencias inesperadas de largo plazo consecutivamente a la irradiación.

DISCUSSION

**Esther Marting, M.D.** (Cincinnati, Ohio): I would like to congratulate the essayists on this splendid paper. Most of us, I am certain, have puzzled long over sections of bone tumors and have often left the microscope with the feeling that malignant tumors of the bone constitute a very complex group. The difficulty in interpreting the roentgenograms adds to the confusion.

By their critical study of a group of round-cell tumors of the bone, Dr. Walker and Dr. Jones have added materially to the scanty data already recorded in the literature. They have again brought to our attention this small group of tumors occurring in bone, namely primary reticulum-cell sarcoma and solitary myeloma, which have a relatively good prognosis when adequately treated. Knowledge of the curability of these lesions even though they may be extensive, and of their benign nature even though clinically, histologically and roentgenographically they appear to be highly malignant, clearly lightens the usual gloomy prognosis. However, if these tumors are to be recognized, it becomes imperative that the surgeon take an adequate biopsy and that the pathologist make an accurate diagnosis. Certainly, the diagnosis should not be made any more difficult for the pathologist by pre-biopsy radiation. The dramatic destructive effect on the cells of a highly radiosensitive tumor by a relatively small amount (750 r) of irradiation, in only twelve hours, is beautifully shown in an illustration in Volume 3 of Pack and Livingston's text on the *Treatment of Cancer and Allied Diseases* (page 2431).

I most certainly agree with Dr. Walker that a therapeutic trial of radiation has no diagnostic value. The only use which it can possibly have is to determine the radiosensitivity of a given tumor, and this is ordinarily done during the course of therapy. If the tumor shows rapid response to radiation, then most certainly the dose should be carried high enough to deliver a tumor-lethal dose. If, however, the tumor responds slowly and appears to have very little radiosensitivity, surgery or some other form of treatment should probably follow irradiation.

In the original paper by Parker and Jackson, published in 1939, it was pointed out that the age distribution and clinical picture of reticulum-cell sarcoma of bone differ from those of generalized reticulum-cell sarcoma, even though the type cell appears identical under the microscope. In the series of cases reported, 40 per cent of the primary reticulum-cell sarcomas of the bone occurred before the age of forty, and 35 per cent before the age of thirty. Of the cases of generalized reticulum-cell sarcoma, 84.5 per cent occurred after forty, and less than 1 per cent under thirty years. Also, in generalized reticulum-cell sarcoma the lesions usually were found in the vertebrae and skull, while in primary reticulum-cell sarcoma of the bone, the lesions were usually in the long and flat bones. These are only generalizations, and study of other cases reported

indicates that primary reticulum-cell sarcoma of the bone may occur at any age and also in the vertebrae. The statement, however, that the patient's general condition in primary reticulum-cell sarcoma of the bone seems to remain unusually good in contrast to the size and extent of the lesion is well borne out in all reports.

Before closing, I would like to ask Dr. Walker several questions:

First, since both primary reticulum-cell sarcoma and solitary myelomas in the bone are highly radiosensitive tumors, there is no reason to doubt that they can be destroyed by radiation therapy alone. What do you consider an adequate tumor dose, and over what period of time would you recommend that the treatment be given?

Second, do you believe that urethane, stilbamidine, radioactive phosphorus, and radioactive strontium have any part in the treatment of solitary myelomas of the bone, before, concurrent with, or following x-ray therapy?

Third, do you feel that Coley's toxin has any value in the treatment of these tumors, before, during, or after x-ray therapy?

**Dr. Walker** (*closing*): Thank you, Dr. Marting, for your discussion and your questions. Regarding tumor dose, it is somewhat difficult to say. I always think that the tumor dose should be dictated more or less by what normal tissues will tolerate. I think we all agree on that. We should go as high as we can, avoiding unnecessary damage to normal and surrounding tissues. After all, we have the patient to contend with if he does survive. I would say certainly 3,500 r to the tumor in these types, but if we can attain 5,000 r tumor dose over a period of thirty days—less if possible—I would subscribe to that.

Regarding urethane, stilbamidine, radioactive strontium, radioactive phosphorus, teropterin, and all the varied drugs which can be used as irradiation adjuncts, I find that they cure no one. We have used all of them, with the exception of radioactive strontium. Radioactive phosphorus was used in one case of reticulum-cell sarcoma primary in bone with metastases to the skin. The patient died of coronary occlusion before we could determine the effect of the treatment.

As to Coley's toxins, there are those who do obtain some apparent improvement by their use, especially Coley.

I would like to state one thing in particular, this type of paper should actually be presented before surgeons, orthopedic surgeons especially. There are those who don't realize what is going on in bone tumors, and I say that with all respect to their knowledge. If you ask orthopedic surgeons what they know about reticulum-cell sarcoma, they don't know much, and they don't know much because they haven't been exposed to it. They don't have it in their literature. If you ever have a chance to talk reticulum-cell sarcoma to an orthopedic surgeon, bring this up. There is waste in cutting off legs or extremities when they could possibly be cured by irradiation. I repeat: "Are the one-legged deaths worth the one-legged cures?"

# Unusual "Bone Tumors" in Infants and Children[1]

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THE PERPLEXING problems inherent in the roentgenologic evaluation of neoplasms of bone are particularly devastating when such lesions and their confusing counterparts in the realm of inflammation and trauma are encountered during the period of active skeletal growth. Admittedly, bone tumor is primarily a disease which occurs during development of the osseous system, but much more so toward the end of skeletal maturation than in the early stages.

There has been a general feeling among physicians that the incidence of primary tumors of bone, especially in children, has shown a steady increase during recent years, the only serious argument being whether or not this increase is real or merely apparent due to more accurate diagnosis. With this in mind, it came as something of a surprise to discover that no appreciable increase of either variety was reflected in our recorded data during the past fifteen years. In proportion to the total number of patients examined roentgenologically, just as many diagnoses of "primary tumor of bone" were made in 1936 and 1941 as were made during the year 1951. Furthermore, the percentage of patients under fifteen years of age was almost identical for each period.

It may well be that the experience at this hospital is not a valid criterion upon which to base the relative incidence of bone tumors at different age periods or during different periods of time. Regardless of the accuracy or significance of these observations, however, there can be no denying the fact that malignant neoplasms of bone currently represent one of the most important causes of death in children. With the previously significant mortality associated with various inflammatory diseases so drastically curtailed, at least temporarily, through the extensive use of antibiotics, it was inevitable that malignant neoplasms in general would eventually emerge as the number one cause of nonaccidental death in children. Recently published figures show that such is the case. For the year 1948, malignant neoplasms caused more deaths in children from five to fourteen years of age than any other disease (1). When one considers that primary bone tumors, including those cases of leukemia with bone involvement, constitute approximately 25 per cent of all malignant growth in this age group, and that they are almost invariably fatal, then their true importance becomes evident. The only encouraging fact which one can derive from this depressing situation is that, despite the frightening statistics cited above, primary malignant bone tumor is still an uncommon entity, accounting for considerably less than one-half of 1 per cent of all pediatric admissions to the University of Michigan Hospital (2), an institution which tends to attract more patients with bone tumors than does the average general hospital.

It is customary in discussing the subject of bone tumors to deal with certain standard items, among which are classification, the relative merits of different methods of diagnosis, and the respective value of surgery, irradiation, and chemotherapy in the treatment of various lesions. All of these issues are extremely controversial and might better be avoided completely, but as they will appear in this discussion by inference, if not directly, perhaps a brief consideration of them is in order.

Any classification of bone tumors is vulnerable to justifiable criticism because of the wide diversity of opinion which

[1] From the Department of Roentgenology, University of Michigan. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

exists regarding the origin, the histopathologic structure, and the very nature of a number of these lesions. Furthermore, considerable confusion still exists in regard to nomenclature. One can merely hope that the present state of confusion bespeaks progress, and that further progress will eventually bring order out of our present state of uncertainty.

As to the relative merits of various diagnostic measures, unbiased, rational medical reasoning dictates that histologic identification of biopsy material constitutes the most reliable aid available. Undoubtedly each of us can recall instances in which the gross roentgenologic appearance of a bone tumor belied the pathologist's histologic report, but how many times did subsequent events prove the roentgenologic interpretation to be correct? One's initial impression may be that such a situation occurs quite often, but if an accurate appraisal of a large number of such cases were to be made, the pathologist's score would be heavy indeed, despite the fact that in most instances he has only small bits of tissue from which to make his diagnosis, whereas the roentgenologist has the opportunity to examine a much larger portion of the tumor. If, as Johnson (3) advocates, full-size histologic sections could be obtained in more instances, the pathologist's score would be still higher.

One could applaud Brailsford's (4) statement that "better evidence is being supplied with increasing accuracy by radiology" if he were referring only to the progress that has been made in this field through the years, but to suggest the radiologic approach as a solution to the "unsatisfactory nature of the evidence provided by biopsy" embodies reasoning beyond the comprehension of this observer.

Actually the roentgenologist and pathologist should co-operate without the slightest feeling of rivalry, since each is capable of enhancing the value of the other's diagnostic efforts. The "going" in the bone tumor field is extremely rough at best, and all too often the most careful correlation of clinical history, physical examination, blood chemistry determinations, roentgenographic findings, and histopathologic study still fails to provide an exact diagnosis.

As this paper purports to be one dealing with the diagnosis of bone tumors, the subject of therapy can be dismissed by stating that, in general, surgery still reigns supreme in the field, but that irradiation, chemotherapy, and hormones all have an important part to play in the management of these lesions.

In the roentgenologic approach to the study of bone tumors, the members of our staff have found it useful to resort to a kind of ritual which, although prosaic and somewhat puerile, is nevertheless analogous to the widely accepted policy in roentgenology of having a carefully disciplined, systematic method of examining, for example, a roentgenogram of the chest. In the latter situation, one steels himself through practice against focusing immediate attention upon an obvious pulmonary lesion, so that he will not neglect the diaphragm, the mediastinum and the thoracic cage, and thus entail the risk of a diagnostic error of omission in one of these regions. In the case of a suspected bone lesion, where neoplasm is obviously a possibility, we believe it worth while for the roentgenologist to view the anatomical part being examined and to ask himself one or more of the following questions in the order given:

1. Is the bone significantly abnormal?
2. If abnormal, is the lesion neoplastic or non-neoplastic?
3. If neoplastic, is the lesion benign or malignant?
4. If malignant, is the lesion primary or metastatic?
5. If neoplastic, can the tumor type be identified?

Using this backdrop of apparent simplicity in roentgenologic analysis as a means of maintaining reasonably firm footing in a field where diagnosis is not only difficult but also conducive to dangerous and unjustifiable speculation, it is my desire to present a group of bone lesions in infants and children which are either truly neo-

plastic or which closely resemble neoplastic lesions in their roentgenographic appearance. The title of the paper indicates that these lesions are unusual, but this is merely a personal opinion. What is considered bizarre by one observer may be routine to another having wider experience. Furthermore, with the rapidly changing concepts in radiology, what may seem unique and unimportant today may suddenly become commonplace tomorrow.

It should be emphasized that this presentation by no means constitutes a comprehensive or representative coverage of the subject of bone tumors in children. The case material has been selected primarily to indicate the wide variety of the lesions which may be seen, to illustrate some of the difficulties encountered in differential diagnosis and, above all, to emphasize the importance of steadfastly adhering to a forthright, conservative, cooperative approach to the bone tumor problem as a whole.

## 1. IS THE BONE SIGNIFICANTLY ABNORMAL?

Among the several anatomic variants which simulate neoplastic disease in the growing bones of infants and children, two are particularly bothersome. These are the so-called *double-contour effect*, confined almost exclusively to infants, and the so-called *cortical defect*, which is much more common in older children.

The double-contour effect (Fig. 1), so designated because there appears to be duplication of the diaphyseal cortex of a tubular bone, is encountered in both premature and full-term infants. Glaser (5), who made a thorough study of this phenomenon, decided that it was due to technical factors, consisting largely of fortuitous relationship of the x-ray tube, bone, and film, in which the x-ray beam happens to transect longitudinal crests in the bone in such a manner as to produce a double shadow. Hancox and his associates (6), in England, however, believe that the double contour is due to a local exaggeration of normal appositional growth of bone. Regardless of the cause, the most important practical aspect of this problem is not to mistake this perfectly normal variant, which eventually disappears of its own accord, for subperiosteal new bone formation such as frequently occurs in malignant neoplasia. The main points of differentiation are that in neoplastic periosteal involvement there is apt to be lamination, the outer layer of new bone is thinner and considerably more delicate than it is in the normal, and there is usually associated bone destruction. In the case of neoplasm, periosteal proliferation extends for a considerable distance around the shaft of the involved bone and thus can be identified in different projections. On the other hand, the double contour effect usually can

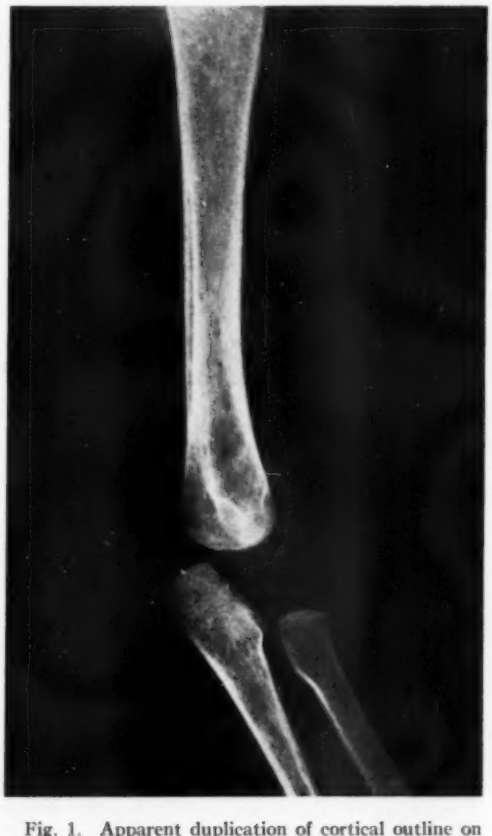

Fig. 1. Apparent duplication of cortical outline on posterolateral aspect of humerus of a normal month-old infant. This normal variant, presumably due to fortuitous projection of the x-ray beam, may be mistaken for abnormal subperiosteal new bone formation. See Fig. 13C.

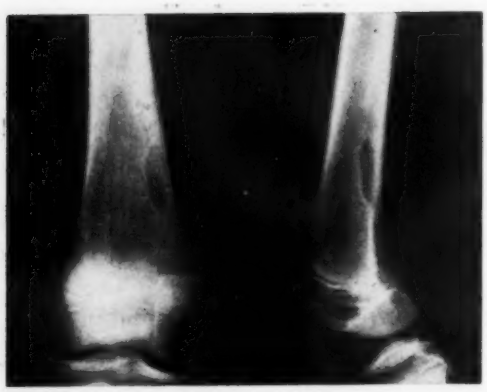

Fig. 2. Oval metaphyseal defect in distal femur of a 12-year-old girl. Only rarely do these extremely common localized cortical foci prove to represent lesions of clinical significance.

be obliterated by changing the position of the bone or the direction of the x-ray beam (Fig. 13C).

Isolated cortical defects occur in the tubular bones of healthy asymptomatic children with surprising frequency and are easily misinterpreted as sites of neoplastic destruction (Fig. 2). Sontag and Pyle (7), who first called attention to these transient localized aberrations in the transformation of cartilage into bone, found them in nearly 50 per cent of the normal boys they examined and in 20 per cent of normal girls. Caffey (8) states that they occur in at least 10 per cent of all growing children, being more common after the age of three years, tending to disappear in later

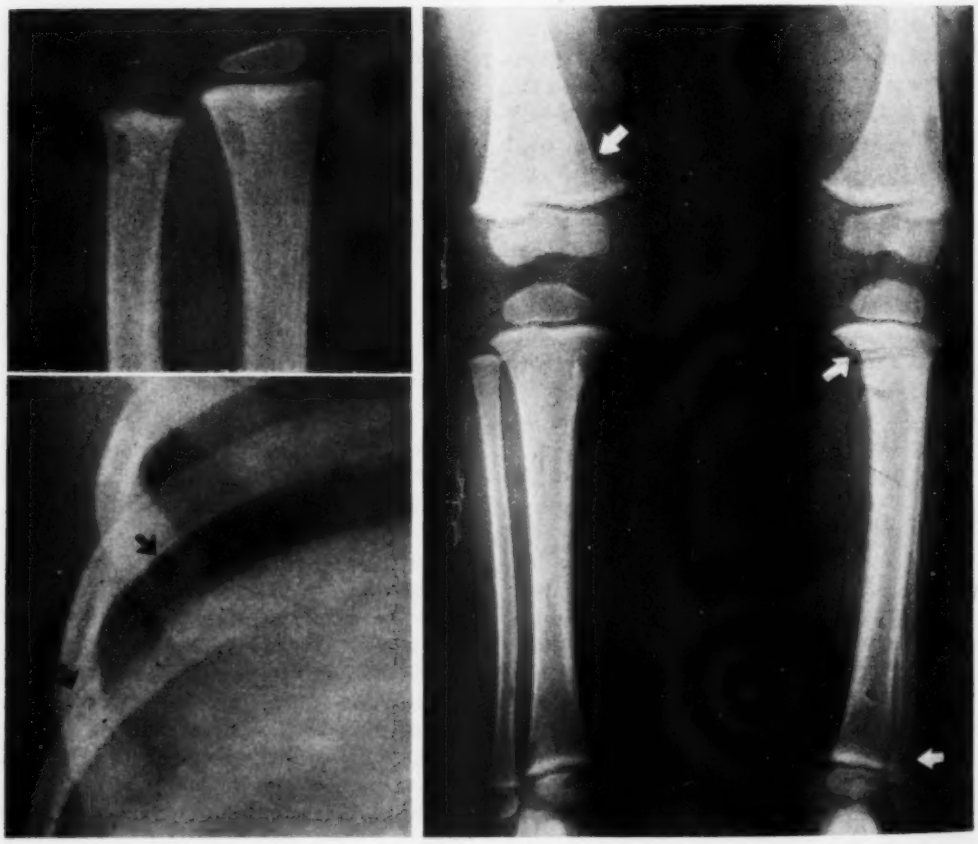

Fig. 3. Multiple cortical defects in an 18-month-old girl with sarcoma of the anus. The cortical location and sclerotic margins of the areas of rarefaction coupled with the knowledge that such foci frequently occur in growing bones ruled strongly against metastases. Subsequent events proved this opinion to be correct.

childhood. They are most often encountered in the medial metaphysis of the femur but, in our experience, have been seen in all of the long tubular bones. Usually they are single but, as will be shown, this is not invariably true.

The cyst-like shadows of cortical defects may be unilocular or multilocular and, although they usually have a smoothly oval or rounded sclerotic margin, the border is occasionally scalloped or otherwise irregular.

Histologically these foci ordinarily contain fibrous tissue with varying numbers of lipoid-containing macrophages and giant cells, which may evoke an erroneous pathologic diagnosis of fibrous dysplasia, lipid histiocytosis, or even giant-cell tumor, if sufficient clinical information has not been supplied to the pathologist.

Because cortical defects are so extremely common in normal children, it is inevitable that they will be encountered in various bone diseases where either localized or disseminated cyst-like lesions are to be expected. One must be extremely careful not to mistakenly identify them as the cause of the patient's symptoms or as roentgenologic evidence of significant skeletal disease.

Perhaps the most unusual example of cortical lesions seen by us was that manifest by an 18-month-old girl who had neurofibrosarcoma of the anus. A skeletal survey showed multiple lytic lesions which, from their individual appearance and location, were interpreted as benign cortical defects rather than metastases (Fig. 3). Although biopsy proof is lacking, spontaneous regression of the bone lesions following successful resection of the patient's sarcoma seems to have substantiated the roentgenologic impression.

### 2. IF ABNORMAL, IS THE LESION NEOPLASTIC OR NON-NEOPLASTIC?

Undoubtedly the prime puzzler in differential diagnosis between neoplastic and non-neoplastic disease is so-called Ewing's tumor *vs.* osteomyelitis. Numerous instances of this perplexing situation have been described and, as it is widely recognized by radiologists, no specific examples will be included in this discussion. Instead, several less common and perhaps less difficult problems will be presented.

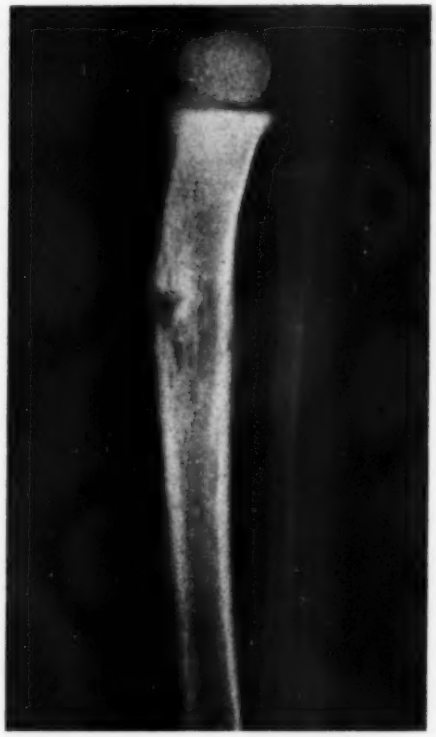

Fig. 4. Reparative process in tibial shaft of an 18-month-old child, incident to repeated blood transfusions into the marrow cavity. Unaware of the transfusions having been given, the roentgenologist suspected malignant neoplasm of bone.

The first patient in this category is an 18-month-old girl with severe microcytic hyperchromic anemia who, when referred for skeletal survey, was found to have the abnormality of the right tibia shown in Figure 4. When excretory pyelography showed a left upper quadrant mass, it was assumed that the patient had neuroblastoma with metastasis to the tibia. Through clinical consultation, however, the mass resolved itself into an enlarged spleen, and the bone lesion proved to be the site of several blood transfusions done by the tibial infusion method at another

hospital. The patient's anemia was diagnosed as nutritional, and her tibia healed without complication. Incidentally, there were no local or general signs of osteomyelitis in the tibia.

The second patient is a 13-year-old boy treated for three years with weight-bearing caliper for Perthes' disease of the left hip. Following three additional months on crutches, he was granted full activity in July 1952, only to return in September with a diagnosis of primary malignant bone tumor made on the basis of roentgenograms obtained by his physician when persistent pain in the left tibia developed, after a fall. The overall roentgenologic appearance (Fig. 5) is that of a typical stress fracture, which the lesion proved to be, but the possibility of malignant neoplasm can scarcely be excluded without careful study.

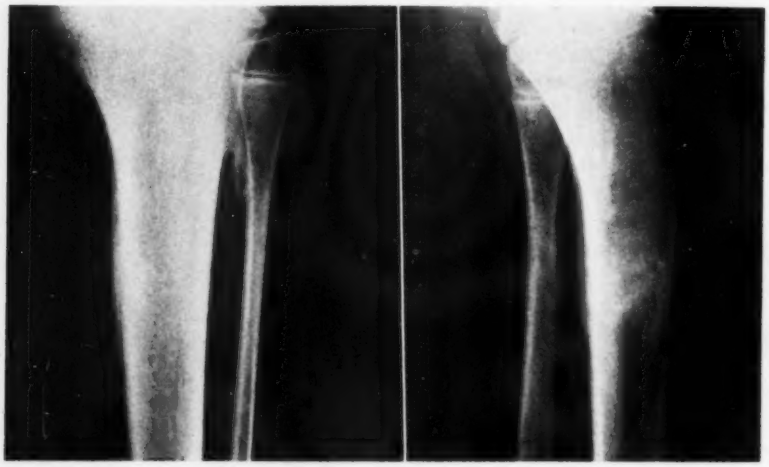

Fig. 5. Stress fracture of proximal tibia with laminated subperiosteal bone formation simulating primary malignant neoplasm. Incidentally, there is a small osteochondroma on the lateral aspect of the proximal tibial metaphysis.

Experience with this patient's case proved to be of considerable practical value as, within six weeks of the time he was seen, an 8-year-old boy who had just finished the usual lengthy non-weight-bearing treatment for Perthes' disease was found to have an identical tibial fracture, also on the same side as the femoral osteochondritis.

Traumatic periostitis may be encountered in infants and children of all ages and, unless an associated fracture can be clearly identified, the possibility of either primary or metastatic malignant neoplasm almost invariably arises. Perhaps the main reason for this is that, although a definite relationship between trauma and neoplasm has not been unequivocally established, the fact remains that some form of injury, however trivial, frequently calls attention to the presence of a genuine bone tumor, whether it be benign or malignant. Two additional non-roentgenologic features concerning trauma are especially worthy of mention. The alkaline phosphatase level of the blood serum may be significantly elevated in the case of a healing fracture in children, and, during certain stages of fracture repair, the histologic appearance of the lesion may be virtually indistinguishable from osteogenic sarcoma.

The third patient in this group is an 8-month-old boy whose extremely swollen right shoulder was exaggerated by his general state of malnutrition. A single roentgenogram of the right shoulder had been made (Fig. 6), a tentative diagnosis of neoplasm was established, and the in-

fant was referred to University Hospital. The immense value of a skeletal survey in infancy is nowhere better exemplified than in this case. Although the diagnosis of scurvy should be seriously considered from the proximal humeral metaphyseal separation which apparently was mistaken for

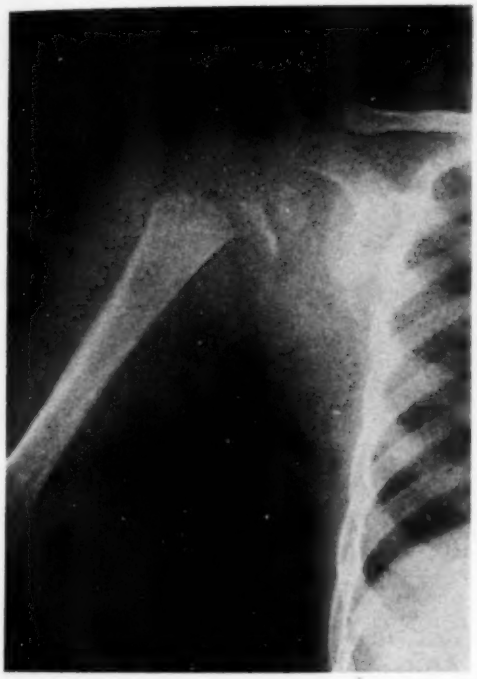

Fig. 6. Complete submetaphyseal dislocation of the proximal right humerus in an 8-month-old infant with scurvy. Soft-tissue swelling (due to hemorrhage), disruption of normal bone contours, and new bone formation (calcification of subperiosteal hemorrhage) contributed to the initial erroneous diagnosis of neoplasm.

tumor bone, the simple expedient of exposing films of the lower extremities proved the diagnosis beyond a shadow of a doubt.

The next patient in this group is an infant of three months, whose parents had noticed, when he was two months old, that he did not use his right arm properly. He was taken to a physician, who diagnosed brachial plexus palsy and referred the baby to an orthopedist. The orthopedist at first confirmed the diagnosis but when, in several weeks, the infant became increasingly irritable and a tumor appeared

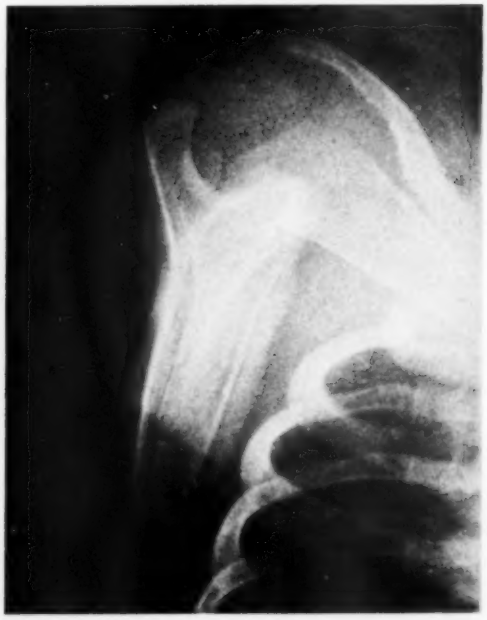

Fig. 7. Lateral view of scapula of a 3-month-old infant with infantile cortical hyperostosis confined to that bone and the mandible. Roentgenologic demonstration of mandibular involvement clinched the diagnosis after orthopedist, roentgenologist, and pathologist initially considered primary neoplasm of the scapula as the cause of the extensive new bone formation.

over the right scapula, roentgenograms were obtained (Fig. 7). The roentgen diagnosis was uncertain, but it was felt that some proliferative inflammatory or neoplastic process was present. Biopsy of the involved scapula furnished the pathologist with histologic material which he interpreted as hyperplastic bone, but he was uncertain as to whether or not it represented a true neoplasm. Because the films were so striking, they were shown to a number of interested individuals and eventually the very obvious possibility of infantile cortical hyperostoses was considered. Careful examination showed questionable soft-tissue swelling of the jaw, and a roentgenogram of the mandible revealed the typical laminated appositional bone formation so characteristic of Caffey's disease. Occasional reports of monostotic cortical hyperostosis are seen in the literature (12) but, in our limited experience, if one makes periodic films of the mandible,

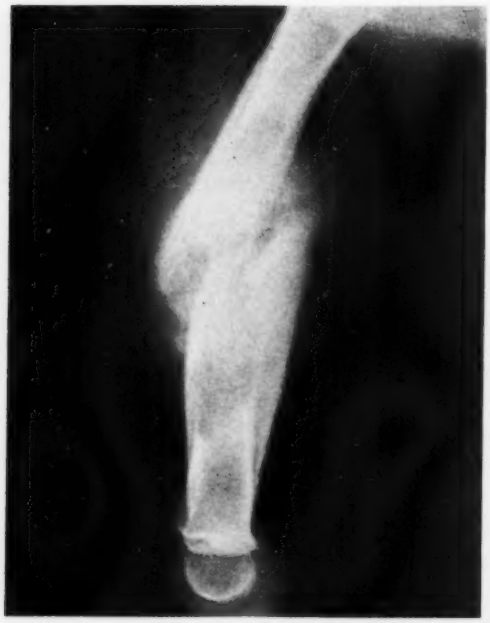

Fig. 8. Monostotic eosinophilic granuloma of femur and "pathologic" fracture with extensive callus formation initially mistaken for manifestations of primary malignant bone tumor.

he will invariably find it to be involved. This supports the far more convincing statement of Caffey (9) himself that he has never seen a case of infantile cortical hyperostosis without involvement of the mandible at some time during the course of the disease.

### 3. IF NEOPLASTIC, IS THE LESION BENIGN OR MALIGNANT?

As one progresses in the evaluation of a possible neoplastic lesion of bone under this simple question-and-answer plan, it becomes evident that the questions become increasingly difficult to answer definitely. Although the examples cited in the previous two categories seem to belie this statement, it should be emphasized that, in the present state of our knowledge, these erroneous diagnoses should not have been made. One should not lose sight of the fact that, despite numerous exceptions, the majority of neoplastic lesions are roentgenologically recognizable as such regardless of the manner in which skeletal architecture has been altered.

Differentiation between benign and malignant tumors of bone, on the other hand, offers considerably greater difficulty, and there are sound basic reasons why this is so. Any experienced tissue pathologist

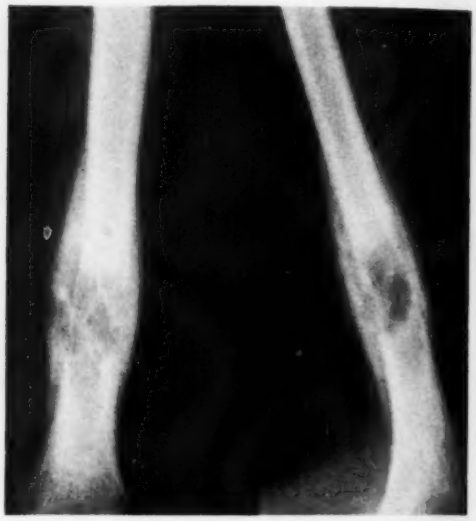

Fig. 9. Right humerus of a 7-year-old boy showing combined destructive and proliferative changes thought to be due to primary malignant neoplasm. The histopathologic diagnosis was bone cyst.

will readily admit that the dividing line between benign and malignant lesions is not sharply defined. Between the obvious extremes is a surprisingly broad intermediate zone where it is extremely difficult to predict from cell morphology alone whether or not a given neoplastic lesion will metastasize. Little wonder then that the roentgenologist, dealing with much cruder diagnostic methods, has similar difficulties. Add to these facts the tremendously exaggerated reparative response to the stimulus of bone destruction which occurs in the rapidly growing bones of infants and children, and one has a readily understandable explanation for the bizarre roentgenologic appearance of the lesions described in the following paragraphs.

The first patient is a 13-month-old boy who one month previously had refused to

stand, rapidly becoming restless and irritable. He was seen by a chiropractor, who said that the right femur was broken and referred the child to a physician. Initial roentgenograms showed a lytic lesion in the mid-portion of the femur diagnosed as osteomyelitis and treated without biopsy by penicillin therapy. Check-up films one week later showed a "pathologic fracture," and the child was sent to the University Hospital, where the clinical and roentgenologic diagnosis was primary malignant bone tumor with neoplastic fracture (Fig. 8).

Histologic examination of biopsy material was unequivocally reported by the Department of Pathology as "eosinophilic granuloma of bone."

Both the fracture and the lytic lesion healed readily with only supportive treatment, and check-up roentgenograms showed eventual complete restoration of normal bony architecture.

The second patient is a 7-year-old boy who complained of intermittent painful swelling of the lower third of the right arm for two months prior to admission. There was no history of unusual trauma. Physical examination showed tender, firm swelling of the lower portion of the right humerus, with slight flexion contracture of the right elbow. When it was discovered that the boy's temperature and white blood count were both slightly elevated, a clinical diagnosis of Ewing's tumor was made.

Fig. 10. Same case as Fig. 9, five weeks and seventeen months following local resection of lesion. The lesion and the large operative defect have healed completely.

The initial roentgenologic diagnosis was "malignant neoplasm, distal portion of right humeral shaft; Ewing's sarcoma suspected" (Fig. 9).

A biopsy was done. The surgeon described onion-peel periosteal bone formation and, on gross examination, thought the extremely vascular lesion which he encountered was a Ewing's tumor.

The pathologist did not feel justified in making a diagnosis of Ewing's tumor on the basis of frozen section and decided that

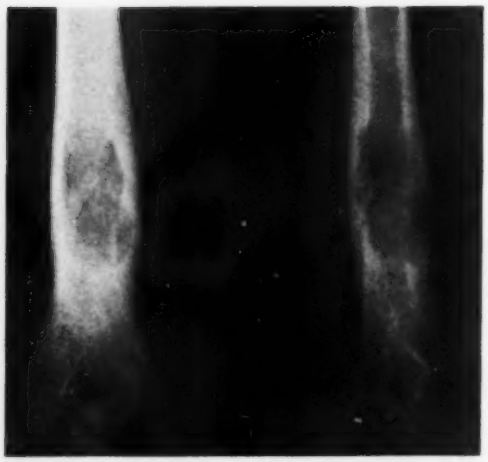

Fig. 11. Osteolytic lesion in the distal humerus of an 8-year-old boy with proved Hodgkin's disease. Histopathologic confirmation of this particular lesion was not obtained. It was discovered on a lateral projection of the chest which fortuitously included the arms.

periodic check-up films (Fig. 10), showing gradual restitution of the humerus to complete normalcy, certainly substantiated the pathologic diagnosis of a benign lesion.

Figure 11 shows a similar appearing lesion in the humerus of an 8-year-old boy with Hodgkin's disease. In many respects it appears more benign and certainly more "cystic" than the lesion just described.

### 4. IF MALIGNANT, IS THE LESION PRIMARY OR METASTATIC?

If one regards leukemia of bone as a form of primary systemic neoplasm, regardless of when or where the lesions are found, then the only serious problem in this category in the age group being considered resolves itself around the differentiation of leukemia from metastatic neuroblastoma. Neuroblastoma probably is the commonest form of metastatic neoplasm in children;

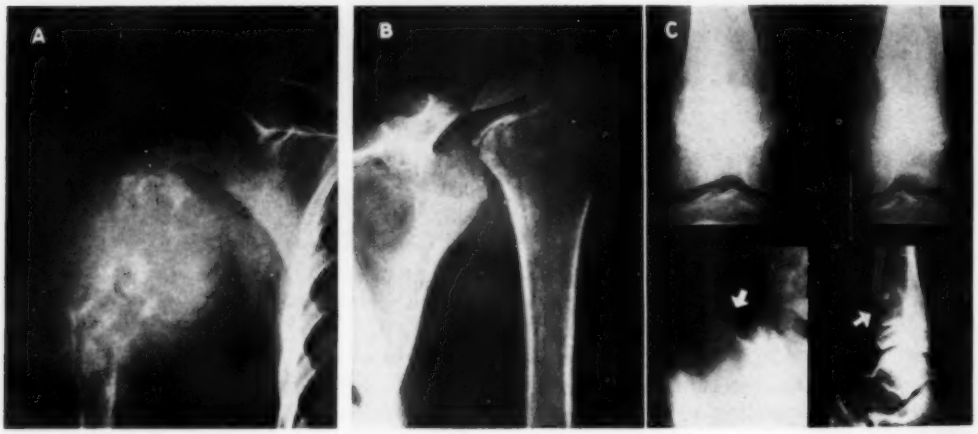


Fig. 12. A. "Sarcomatous chondroblastoma" of right humerus treated by forequarter amputation on May 23, 1950. Films of the left shoulder made for comparison showed no abnormality.
B. Destructive lesion in head of left humerus as seen on Oct. 31, 1950. Biospy showed "spindle-cell sarcoma arising in chondroblastoma."
C. Unusual distribution of metastases identified by skeletal survey on Nov. 8, 1950. Patient died two months later.

final diagnosis must await permanent sectioning of the biopsy material. His final report was: "a so-called traumatic bone cyst. Marked osteoblastic and osteoclastic activity with granulation tissue, hemorrhage, and osteoclastic giant cells."

Both the surgeon and roentgenologist felt that the pathologist was in error, but it frequently involves bone, and often is roentgenologically indistinguishable from leukemia. Numerous examples of each of these neoplasms could be presented, since they constitute the commonest manifestations of malignant bone disease in infants and young children. Silverman (10), Caffey (8), and others have dealt ex-

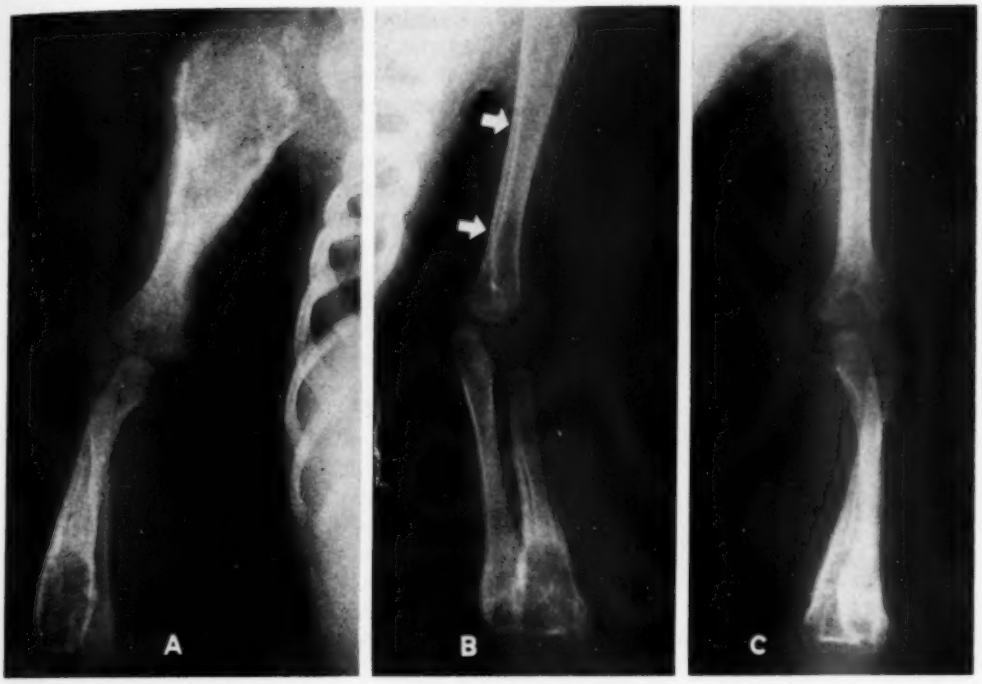


Fig. 13. Unique destructive and proliferative lesions involving right humerus, right radius, right ulna, left radius, and left ulna. Similar lesions were found in both femurs, the left tibia and fibula, and the left seventh rib. Roentgenologic diagnosis was malignant neoplasm of indeterminate type. Pathologic diagnosis based upon biopsy and extensive necropsy was malignant hemangioblastoma.

Initially the left humerus (arrows in B) was thought to be involved, but a right-angle projection (C) suggests that the apparent periosteal new bone formation is a manifestation of the normal "double contour effect" illustrated in Fig. 1.

haustively with these lesions, and their excellent descriptions will not be repeated here. To illustrate the difficulty sometimes encountered in distinguishing between metastatic and primary malignant bone tumors, two examples will be presented which are unusual not only in the distribution of the lesions but also extraordinary in the final histologic diagnosis.

When one observes the multiple destructive foci found in a skeletal survey of a 12-year-old boy (Fig. 12C), it appears that any one of these lesions could represent a primary malignant bone tumor. It is equally obvious that in the light of past experience these destructive foci could be manifestations of some form of lymphoblastoma and, as such, again might be considered "primary." When one learns, however, that a lytic lesion of the left humerus had been found a week earlier (Fig. 12B), and furthermore that a far more extensive destructive process had been found in the proximal portion of the right humerus five months before that (Fig. 12A), one immediately thinks of Ewing's tumor because of its unique feature of arising in one bone and metastasizing to other skeletal parts. Actually, biopsy of each humerus on separate occasions showed chondrosarcoma, which ordinarily occurs in a much older age group, grows slowly, and, so far as I have been able to determine, has never been reported as producing bone metastases.

The other patient is a 3-month-old girl who had become increasingly irritable since the age of a month and a half and was found to have firm, hard swellings over the right shoulder, both wrists, the right knee, and the right ankle. Roentgenograms showed extremely bizarre destructive and prolif-

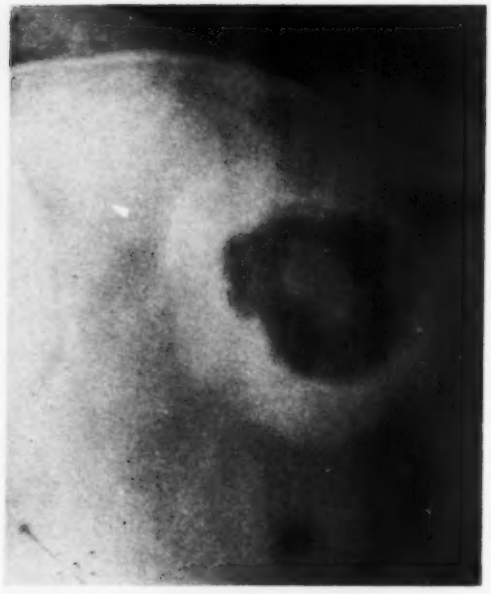

Fig. 14. Unusual lesion in left iliac wing thought to be a large osteoid osteoma. It proved to be an hemangioma, a diagnosis which should have been considered in light of the similarity between this lesion and some reported examples of hemangiomas of the skull.

erative foci involving multiple long bones, the thoracic cage, and the right scapula (Fig. 13). Although the exact etiology was considered indeterminate, some form of malignant neoplasm was suspected. A biopsy of the left tibia was reported as showing "hemangio-endothelioma destroying bone. More malignant than ordinary multiple hemangioma." The infant was given amino-an-fol therapy, but her course was steadily down hill and she died approximately six weeks after admission to the hospital. The final pathologic diagnosis, based upon a thorough autopsy, was "hemangioblastoma in ends of long bones, ribs, pancreas, subpleural portions of lungs and retroperitoneal tissues. Extreme myelophthisis. Eosinophilia of bone marrow, spleen, and lymph nodes. Amino-an-fol therapy. Cachexia. Lipidosis of heart and kidneys. Fibrous atrophy of thymus. Fungus infection of stomach and intestines. Dilatation of ducts of breast. Cerebral edema."

According to Lichtenstein (11), hemangioendothelioma of bone is an extremely rare, highly malignant neoplasm which, so far as he knows, never develops through malignant change in a benign hemangioma. Coley (12) believes that these tumors are best classified as Ewing's tumors and, interestingly enough, points out that they may resemble eosinophilic granuloma. The latter statement furnishes ample room for speculation concerning the case just described, in view of the extensive eosinophilia and lipidosis mentioned in the autopsy report.

### 5. IF NEOPLASTIC, CAN THE TUMOR TYPE BE IDENTIFIED?

There is no reason why the roentgenologist should not exercise his prerogative of speculating as to the exact cell type of a suspected bone tumor so long as he clearly recognizes that microscopic characteristics are not necessarily accurately reflected in gross appearances, whether these are evaluated in the flesh or as shadow images on the x-ray view box. Moreover, many of the time-honored roentgenologic signs considered at one time to be virtually pathognomonic have, through years of experience, proved to be of distinctly limited diagnostic value, as the so-called "punched-out" lesions of multiple myeloma, the soap-bubble appearance and the epiphyseal location of giant-cell tumor, the loculated vacuum of solitary bone cyst, the onion-peel appearance of Ewing's sarcoma, and the sunburst effect of osteogenic sarcoma. Some of these classic concepts have been shown to be basically fallacious and again the findings have been repeatedly observed in other neoplastic lesions as well as in various inflammatory and pseudoneoplastic conditions. Two examples will serve to demonstrate the futility of relying too heavily upon supposedly diagnostic roentgenographic signs.

There is still considerable controversy as to whether osteoid osteoma is an inflammatory or neoplastic lesion, but regardless of its morphology, its roentgen appearance is one of the most consistent and easily recognized of all bone lesions.

A 15-year-old girl who complained of intermittent pain in her left hip, gradually increasing in severity over a period of three years, was found to have a lesion in the left ilium as shown in Figure 14. The central nidus surrounded by a zone of diminished density, which in turn was bounded by an area of sclerotic bone, seemed to fit the characteristic appearance of osteoid osteoma almost too perfectly. A wedge resection of the lesion was done, and the pathologist's interpretation was "hemangioma with marked proliferation of bone and connective tissue."

The second example is a 23-month-old girl who was found to have a hard, firm, tender swelling of the right femur, which clinically was thought to be an osteogenic sarcoma. Roentgenograms (Fig. 15) showed a destructive and proliferative lesion with a spectacular "sunburst" effect which seemed to substantiate the clinical diagnosis. Disarticulation of the hip afforded opportunity to make a histopathologic study of the entire lesion, and it was found to be a primitive hemocytoblastoma, a form of lymphoblastoma.

Fig. 15. Spectacular "sunburst" effect in femur of 2-year-old girl. Osteogenic sarcoma was suspected clinically and roentgenologically, but the pathologic diagnosis was lymphoblastoma. Subsequent development of lesions in other bones further substantiated the pathologist's opinion.

## SUMMARY

The roentgenologic study of bone tumors in infants and children is confusing and, at times, exasperating, but it is seldom, if ever, dull. As the result of the normal rapid mineralization and exaggerated reparative response to bone destruction which takes place during early skeletal growth, neoplastic or pseudo-neoplastic processes appearing during this period are apt to be more unusual in their roentgenographic manifestations than similar lesions in older individuals.

The radiologist should have no feelings of complacency about his current diagnostic procedures as applied to tumors of bone, whether they be in children or adults; although good, roentgenologic examination still leaves much to be desired. It appears that these methods are most effective in discovering abnormalities of bone, in determining their extent, and in identifying those which are neoplastic, but even at these elementary levels there are distinct limitations which should be clearly recognized and readily admitted. When it comes to differentiating benign lesions from those which are malignant, histologic examination of biopsy material generally is more reliable than roentgenologic examination alone. It is evident, however, that neither method approaches infallibility, and, in most instances, one should complement the other.

Discouraging indeed is the frequency with which relatively innocuous lesions are mistakenly diagnosed as malignant tumors, with all of the attendant psychic, social, and economic complications for the patient, his family, and his physician. More serious, but fortunately less commonplace, is the irreparable tragedy of erroneously diagnosing an early malignant tumor as a benign process, and thus postponing possible curative therapy. In the present state of our knowledge and ability, the radiologist can help keep such unfortunate occurrences to a minimum by evaluating each bone tumor problem with a forthright systematic approach, and by engaging in active personal consultation with his colleagues in clinical medicine and pathology. He should recognize his limita-

tions, yet stand firm in his opinions when they are based upon sound evidence. Finally, he should continue the search for more specific means of identification which will make roentgenologic diagnosis more accurate in its own right.

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## SUMARIO

### Extraños "Tumores Oseos" en Lactantes y Niños Mayores

El estudio roentgenológico de los tumores óseos de los niños, incluso lactantes, se presta a confusión. A consecuencia de la rápida mineralización normal y de la exagerada respuesta a la destrucción ósea que tiene lugar durante el desarrollo temprano del esqueleto, es probable que los procesos neoplásicos o seudoneoplásicos que aparecen durante dicho período muestren más extrañas manifestaciones roentgenológicas que las lesiones semejantes observadas en personas de mayor edad.

Un aborde propuesto para el estudio de las radiografías óseas toma la forma de las siguientes preguntas:

1. ¿Es el hueso significativamente anormal?
2. Si es anormal, ¿es o no la lesión neoplásica?
3. Si es neoplásica, ¿es la lesión benigna o maligna?
4. Si es maligna, ¿es la lesión primaria o metastática?
5. Si es neoplásica, ¿cabe identificar el tipo del tumor?

Preséntanse casos que demuestran las dificultades encontradas al buscar las respuestas a esas preguntas. A pesar de numerosas excepciones, pueden reconocerse roentgenográficamente como tales a la mayoría de las lesiones neoplásicas, independientemente de la forma en que se haya alterado la arquitectura esquelética. En cambio, para la diferenciación entre las lesiones benignas y las malignas, para distinguir entre tumores primarios y metástasis, y para determinar el tipo de los tumores, el examen histológico del material biópsico resulta en general más fidedigno que el examen roentgenológico por sí solo. El roentgenólogo puede, claro está, teorizar acerca del tipo exacto de las células de un tumor óseo sospechoso, pero siempre reconociendo que las características microscópicas no se reflejan forzosamente en el cuadro macroscópico radiográfico.

El radiólogo puede ayudar a reducir a un mínimo los diagnósticos erróneos justipreciando cada problema planteado por un tumor óseo con un criterio sistemático y recto y entablando una activa consulta personal con sus colegas dedicados a la clínica médica y a la anatomía patológica. Aunque reconociendo sus limitaciones, debe mantenerse firme en sus opiniones cuando se basan en datos positivos. Por fin, debe

continuar buscando medios más específicos de identificación que doten de mayor exactitud al diagnóstico roentgenológico por su propia cuenta.

## DISCUSSION

**Wm. A. Evans, M.D.** (Detroit, Mich.): Dr. Holt's paper interests me very much, as it concerns the function of the roentgen diagnosis. Our endeavor is to give a maximum amount of useful information subject to a minimal amount of error. For example, we can recognize with reasonable accuracy a foreign heavy metallic deposit in growing bones. We are not chemists, but today it would be a reasonable assumption that this deposit is lead. Yesterday it might have been bismuth, and tomorrow it may be uranium. Likewise, we can recognize a metastatic neoplastic infiltration in growing bones with reasonable accuracy, and that to us is a satisfactory and complete roentgen diagnosis. We might further suggest the probability of leukemia or neuroblastoma, but to distinguish between these two common types of infiltration, not to mention rarer types, often brings us into error. On the other hand, the pathologist also has his limitations.

I have been told that one who confines his attention to the microscope finds it virtually impossible to distinguish between the cell of neuroblastoma and that of Ewing's tumor, but the error of this confusion has been accepted by clinicians and radiologists and may be found in the radiological literature. Of course, all available information is desirable in attempting to make a final diagnosis. We are in an unfortunate position for this purpose in many instances, in that we are the first to recognize a lesion. Then follow the history, the physical examination, the laboratory work, the surgical exploration, and finally the microscopic study. No wonder the pathologist has the "final" word. If the patient is dead, the pathologist is usually granted that by courtesy, but when the patient lives, we have all seen instances where that "final" word must be modified.

A more fundamental problem is the diagnostic classification that we use. I venture to suggest that but for the accident of history that Virchow was born before Roentgen, we would have a different classification of diseases of bone today. Even so, some of our diagnostic labels vary in fashion and in favor from year to year. At best, they approximate our current understanding, and at worst they are a pretentious and arbitrary cloak of our ignorance. In short, I am in sympathy with Brailsford's declaration of release of the radiologist from complete acquiescence to the pathologist. This does not imply indifference, but calls for the development on our part of a classification of lesions of bone by roentgen criteria that will be a useful and reliable guide to prognosis and treatment. Dr. Holt has given us a lead in that direction which we would do well to follow.

# Borderlands Dim in Malignant Disease of the Blood-Forming Organs[1]

R. PHILIP CUSTER, M.D.[2]

IT IS IN DEALING with malignant disease of the blood-forming organs that teamwork between the radiologist and pathologist assumes its utmost importance, for here one faces so often a changing situation. In this group of malignant processes, it is impossible to catalogue once and for all time a given form of lymphoma or leukemia and be certain that it will retain that form throughout its course. Serial biopsies are frequently informative, and the more cases followed in such fashion, the clearer the point I have just made will become. I do not recommend slowly taking the patient to bits, but a second or third biopsy, or even more, especially at times when the disease is not responding as anticipated, will in the long run do more good than harm. Close observation of the blood picture, as well, by a pathologist who has had clinical contact with the patient is another requirement. Alterations in the character of the disease can often be anticipated by this means.

With this preamble, let us turn to tumors generally grouped under the heading of malignant lymphoma, and to two forms of leukemia most closely associated with them, the lymphocytic and monocytic types. I have classified the lymphomas in conventional style according to their predominating histological pattern as the *follicular type*, characterized by nodules resembling lymphoid follicles, the *lymphocytic type*, with uniform, mostly round cells, the *reticulum-cell type*, with cellular pleomorphism, and the *Hodgkin's type*. Following Jackson and Parker, Hodgkin's lymphoma is subdivided into the *paragranuloma*, with predominance of small lymphocytes, the *granuloma*, with reticulum cells, fibroblasts, granulocytes, and plasmocytes more or less conspicuous, and the *sarcoma*, which is virtually the same as a reticulum-cell lymphoma.

An interrelationship between these forms of lymphoma has long been known but seldom publicized. There is no time to review the literature. Suffice it to say that, by joining isolated records, one can construct the same scheme of linkage that I am presenting, the latter based solely on personal observations of well over two thousand cases. Thus, I am not offering anything really new.

Transitions actually observed are shown in the accompanying diagram (Fig. 1), the solid lines representing relatively common ones, the dotted lines those less frequently encountered.

It is generally accepted that follicular lymphoma rarely remains as such throughout its course. After some unpredictable length of time, varying from a few weeks to twenty years or more, the follicles fade or coalesce during the transformation to a more diffuse, and mostly a more malignant, type of lymphoma. One can often predict from a biopsy the direction of change, once the process has begun. As the diagram shows, at least six possibilities exist. In my experience, the swing has been most frequently toward reticulum-cell or Hodgkin's sarcoma, terms that I have come to use synonymously, with lymphosarcoma of a well differentiated type next in order. A change to Hodgkin's paragranuloma is no rarity, and in some of our cases sequential biopsies have revealed a further progression through the granuloma to the sarcoma, a progression that is very common within the realm of Hodgkin's disease

[1] Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

[2] Director of Laboratories, The Presbyterian Hospital in Philadelphia; Associate Professor of Pathology, The University of Pennsylvania; Pathologist, Radiological Division, The Philadelphia General Hospital; Consultant, The Armed Forces Institute of Pathology, Washington, D. C.

proper. Follicular lymphoma eventuating as lymphocytic leukemia occurs not infrequently, while a change to monocytic leukemia has but rarely been observed.

Moving downward on the diagram, we come to the Hodgkin's group; the instability here has been mentioned, and it should be emphasized that in a great many instances a mixed histologic pattern will be found, sharing paragranulomatous, granulomatous, and/or sarcomatous features.

a great many of these tumors is a mixed one, as I have mentioned in the case of Hodgkin's disease. The direct change from Hodgkin's paragranuloma and granuloma to a diffuse round-cell tumor occurred in but few of our cases, in some instances representing only one component of a mixed picture.

A transformation that I have seen but twice is shown on the left of the diagram, *i.e.*, well differentiated lymphocytic leukemia

TRANSITIONS OBSERVED AMONGST TYPES OF LYMPHOMA

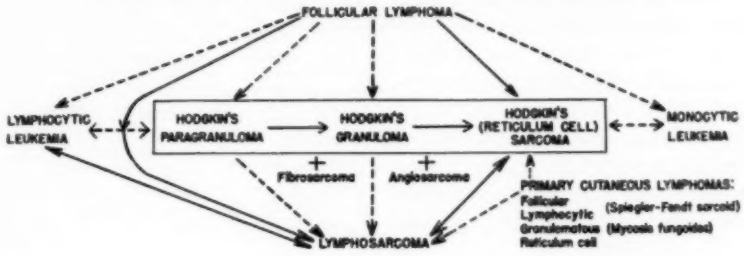


Figure 1

In the lower left, a double-headed arrow is seen connecting lymphocytic leukemia and lymphosarcoma. In the one direction this denotes a case with the systemic proliferation, and generally the blood picture, of leukemia, with development of a tumor that grows, infiltrates, and metastasizes as a unicentric sarcoma. The opposite situation may develop in a patient who initially presents the tumor and later shows a leukemic blood picture, with or without leukemic metaplasia in the various organs and tissues. I do not believe that the so-called "lymphosarcoma-cell leukemia" deserves a separate designation; it is merely a link in this complex.

A similar relationship between monocytic leukemia and reticulum-cell sarcoma is indicated at the far right, although this is a relative rarity.

The two-directional bond shown between lymphosarcoma and reticulum-cell or Hodgkin's sarcoma is another that is generally recognized. Warren and Picena some years ago devoted an article to illustrating all stages of the transition, and emphasizing that the histologic pattern in ultimately presenting histologic features of Hodgkin's disease, the granuloma in one instance and combined paragranuloma and granuloma in the other, complete with typical Reed-Sternberg cells. We were reasonably sure that this was not merely a leukemoid reaction, one patient having been followed for seven years prior to death, during which time he presented typical features of leukemia.

The primary cutaneous lymphomas are given particular attention here, because dermatologists, or at least some dermatologists, would have us believe that these lesions are something quite apart. It was good to hear Dr. Holmes, in his account of Dr. Walter Cannon's illness,[3] recognize the close relationship of mycosis fungoides to other forms of lymphoma. Actually, cutaneous lymphomas do not differ in essence from lymphomas arising primarily in nonlymphatic tissues anywhere in the body, even though some tend to remain confined to the skin for long periods of time. Their

[3] Presented before the Radiological Society of North America, Dec. 11, 1952. Published in Radiology 61: 3, 1953.

microscopic patterns conform to those of lymphomas at large, Spiegler-Fendt sarcoid incorporating the follicular and diffuse lymphocytic varieties, mycosis fungoides the granulomatous, and reticulum-cell sarcoma the tumor so designated elsewhere. If the patients do not die of other causes in the interim, systemic lymphomatosis develops, often but not necessarily of the same microscopic type. For example, the primary lesion in a young girl was diagnosed Spiegler-Fendt sarcoid, the corium of the skin being occupied by a uniform sheet of small lymphocytes. The autopsy disclosed a rather generalized spread of the tumor, the final microscopic appearance of which was that of reticulum-cell sarcoma. These fundamental principles pertaining to cutaneous lymphomas may be applied to lymphomas arising primarily in the respiratory, gastrointestinal, genitourinary, and even the central nervous systems.

You may think it strange to find fibrosarcoma mentioned in this connection. The fibroblast, however, is frequently a conspicuous component in Hodgkin's granuloma, and we occasionally find some of the tumors in this disease to be made up entirely of neoplastic fibroblasts, tumors that would unquestionably be called fibrosarcoma if seen alone. This is well illustrated by a patient whose stomach had been resected along with a retroperitoneal mass a year previously, the diagnosis of Hodgkin's granuloma having been made. On admission to our hospital, the liver was massive, although it retained its normal contour and proportions. Treatment with nitrogen mustard was followed by a spectacular reduction in the size of the organ, save for an ovoid mass near the midline, which became more and more evident as the organ shrank. This tumor continued to grow, despite local x-ray therapy, and at autopsy was found to be a fibrosarcoma, no evidence of the lymphomatous process remaining.

In much the same fashion, the angioblast may participate occasionally to form tumors or portions of tumors that alone would fit in the category of angiosarcoma. This is seen, however, more rarely than fibrosarcoma as an associate of lymphoma.

VARIANTS OF CHRONIC GRANULOCYTIC LEUKEMIA

| TYPICAL | DATA | VARIANT |
|---|---|---|
| Adult | AGE INCIDENCE | Congenital or Childhood |
| Present | CLINICAL MANIFESTATIONS | Absent |
| Increased | GRANULAR LEUKOCYTE COUNT | Normal or Decreased |
| Predominantly Neutrophilic | TYPE OF GRANULAR LEUKOCYTE | Eosinophilic or Basophilic |
| Predominantly Mature | MATURITY OF GRANULAR LEUKOCYTE | Acute Myeloblastic Crises |
| Normal or Decreased | ERYTHROCYTE COUNT | Increased |
| None to Moderate Numbers | CIRCULATING NUCLEATED RED BLOOD CELLS | Great Numbers |
| Normal or Decreased | THROMBOCYTE COUNT | Increased |
| None to Moderate | ASSOCIATED MEGAKARYOCYTOSIS | Excessive |
| Excessive Granulopoiesis | BONE MARROW | Fibrous or Bony Replacement |

Figure 2

In summation thus far, malignant lymphoma appears to be a single neoplastic process having a multiplicity of histologic patterns. The pattern may be a static one throughout the course of the disease, but it is frequently a changing one, and two or more patterns may exist in the same patient, even in the same tumor mass.

Two types of *leukemia*, lymphocytic and monocytic, have been found intimately related to the lymphomas, actually a part of them. It is not so easy to construct a bridge to other leukemias on the basis of current data. I know of several cases in which reticulum-cell sarcoma and chronic granulocytic leukemia coexisted in the same patient, but one may argue that this was fortuitous. If, however, one is willing to cross this flimsy bridge, the going becomes easy once more.

Several years ago, Doctors Butcher and Meek and I presented an analysis of chronic *granulocytic leukemia* to emphasize the great variability occurring within this

single category, our data being summarized in the accompanying chart (Fig. 2).

Several items are of considerable significance in the present connection, namely, the occurrence of erythrocytosis and erythroblastosis, and of thrombocythemia

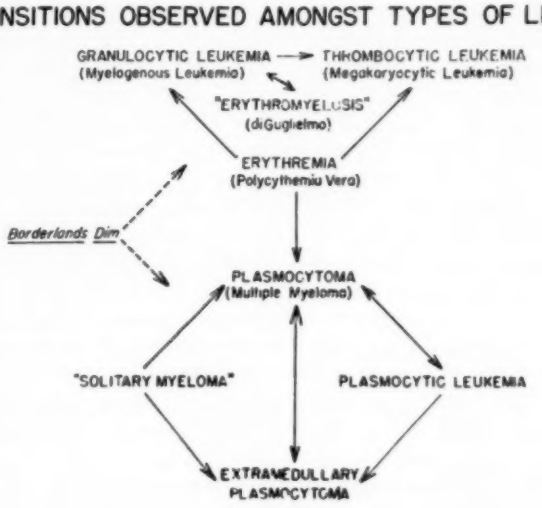


Figure 3

and megakaryocytosis, in certain patients whose disease was otherwise typical of chronic granulocytic leukemia. This was evidence of the mass reaction of which the bone marrow and extramedullary foci of blood formation were capable. In other words, the erythrocytic and thrombocytic series could share the purposeless proliferation initially manifest by the granulocytes. The bizarre forms of megakaryocytes encountered under such circumstances further stamped them as neoplastic.

A few of these patients with thrombocythemia were followed into a phase in which the cellular features of granulocytic leukemia became subordinate to megakaryoblastic and megakaryocytic proliferation, with uncountable masses of thrombocytes appearing in the peripheral blood. They were then necessarily classed as *thrombocytic* (or megakaryocytic) *leukemia*.

The mass reaction of the blood-forming tissues is also a feature of *erythremia* (polycythemia vera). Indeed, that is one of the surest means of distinguishing this neoplastic disease from compensatory erythrocytosis, where study of the bone marrow shows the hyperplasia confined largely to the erythrocytic series. The abundant megakaryocytes in erythremia are often atypical, as they are in chronic granulocytic leukemia, and their numbers have in a few instances been overwhelming, signifying a change to thrombocytic leukemia.

The best known transformation within this group is the one from erythremia to granulocytic leukemia, occurring in as high as 15 per cent of cases in some series. In the majority of such patients, the blending is a gradual one, and the leukemia well differentiated in type. Less often erythremia terminates in a burst of myeloblasts.

Attention has been focused recently on a rare condition publicized by di Guglielmo, generally spoken of as "erythromyelosis," a condition analogous to leukemia, in which the nucleated elements of the erythrocytic series are concerned. At least three such cases have reportedly eventuated in granulocytic leukemia. Within the past three weeks one of our patients who had previously presented the classical picture of chronic granulocytic leukemia, well con-

trolled by chemotherapy, suffered an acute relapse characterized by fever, prostration, and a rapidly progressive anemia and thrombocytopenia. Instead of the anticipated myeloblastosis of blood and bone marrow, the malignant cells were identified as belonging to the erythrocytic series, chiefly proerythroblasts. So here we have an example of transition from well differentiated granulocytic leukemia to a rather anaplastic erythromyelosis, the first instance of which I am aware. (Since this paper was presented, the patient experienced a striking remission induced by treatment with ACTH, but now, four months later, she has had another relapse and is under treatment with folic acid antagonists, the results of which are not yet apparent.)

Again we come to a narrow bridge, but one not so shaky as before. Three of the four cases reported by Lawrence and Rosenthal, and three others from the previous literature are acceptable as examples of erythremia terminating as *plasmocytoma*. This combined incidence is probably significant, in view of the uncommonness of each and the relative proportion of actual cases to appear in the literature. No such sequence has been found in our own series, however.

We strike solid ground again in the field of neoplastic plasmocytes. The situation here is quite similar to that with lymphoma and not so complex, in that only one cell type is involved. The categories are purely regional, and the histologic aspects are complicated only by the degree of differentiation of the tumor cells, specifically when they are so anaplastic as to resemble reticulum-cell sarcoma. The arrows (Fig. 3) denote the anatomical changes that we have observed in a fairly large series of patients and require no particular explanation.

To understand the interrelationships that I have described, one must bear in mind the fact that all of these neoplastic processes have as their common bond the origin of their cellular components in the reticulo-endothelial system. Cells of the reticulo-endothelial system may be regarded as counterparts of embryonal mesenchyme and, as such, retain multipotential qualities throughout life, especially with respect to hematopoiesis. They remain the stem cells of the blood-forming, lymphatic, and connective tissues, and their distribution throughout the body is virtually universal. Finally—and this is very important—the concept of the cell as a static unit must be discarded.

In the brief space allotted to this paper, it is manifestly impossible to present examples in proof of the statements I have made. Most cases on which the diagrams are based are on file in my laboratories or at the Armed Forces Institute of Pathology, the few gaps are filled by cases recorded in the literature by reliable authors.

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SUMARIO

**Límites Obscuros en las Afecciones Malignas de los Órganos Hematopoyéticos**

El concepto expuesto aquí de las enfermedades malignas de los órganos hematopoyéticos considera como variantes histológicas del mismo proceso fundamental a entidades neoplásicas supuestamente específicas como son la enfermedad de Hodgkin, el linfosarcoma, el sarcoma retículocelular, etc. Ocurren transiciones de una forma a otra de enfermedad, y pueden encontrarse combinaciones de varias de ellas en el mismo individuo.

Por ejemplo, el linfoma folicular rara vez continúa como tal durante toda su evolución. La transición más frecuente, en lo observado por el A., es a retículosarcoma (sarcoma de Hodgkin); en otros casos, la transición puede ser a linfosarcoma bien diferenciado, a paragranuloma de Hodgkin, sarcoma, leucemia linfocítica o raramente a leucemia monocítica. Así también, puede encontrarse un patrón histológico mixto en la enfermedad de Hodgkin, comprendiendo

características paragranulomatosas, granulomatosas y/o sarcomatosas. Entre otras relaciones figuran las que existen entre las formas linfocítica y monocítica de la leucemia y las de la eritremia y eritromielosis con la leucemia granulocítica.

Para comprender esas y otras interrelaciones discutidas en este trabajo, hay que tener presente que todos dichos procesos neoplásicos tienen en común como característica el origen de sus componentes celulares en el sistema reticulo-endotelial. A las células de ese sistema hay que considerarlas como análogas del mesénquima embrionario, que retienen, toda su vida en esa capacidad, propiedades multipotenciales, en particular con respecto a hematopoyesis. Continúan siendo las células orginarias (premieloblastos) de los tejidos hematopoyético, linfático y conjuntivo, y su distribución por todo el organismo es virtualmente universal.

## DISCUSSION

**Edward Gall, M.D.** (Cincinnati, Ohio): I want first to express a word of appreciation for being permitted to partake of Dr. Custer's enormous fund of knowledge in this field. I would be hesitant to interpose any contrary thoughts on the subject and I shall limit myself judiciously to a few speculative impressions garnered in the study of this group of disorders.

The first point that I should like to make has to do with the matter of apparent transition of one form of lymphoma to another. Some years ago, working with Doctor Castleman in Boston, I took part in assaying the histologic interpretation of a series of duplicate biopsies, or specimens—more than one specimen removed from a single patient at different times. We set ourselves an arbitrary interval of two months. We found transition just as Doctor Custer has indicated, and in a proportion of approximately 30 to 40 per cent of the cases. It occurred to me, however, that perhaps a two-month interval was much too arbitrarily selected, and so an additional series of duplicate specimens was studied in which the interval was less than two months. Indeed, in some the interval was only twenty-four hours or a week. It was found that, although the variation was not as great, none the less it was still present.

I pose this question then: Does this actually represent a gradual change in the type of lymphoma, or does it mean that, with a single underlying impetus for the development of a neoplasm, whatever that may be, there actually may be simultaneous variation in morphologic response in different parts of the body?

My second point has to do with the disease called mycosis fungoides. A number of years ago I made the statement, as Doctor Custer has done today, that mycosis fungoides was one of the lymphoma group. I think that, if one establishes that as a criterion, there can be no variation from it. However, in subsequent years I became more and more exposed to the ire and expostulation of my dermatologist colleagues, who were seeing a considerable variety of cases which they would classify as mycosis fungoides on the basis of clinical criteria. Many of these, on biopsy, failed to show any evidence of lymphoma. I learned, as all of us do when we expose ourselves to the experience of others, that they had a definite entity so far as clinical dermatology was concerned, but not a single entity histologically. In a number of these cases changes did ultimately develop which were unmistakably those of lymphoma. However, to carry the pattern a little further, I was able to collect some 53 cases with malignant lymphoma, and with dermatological alterations which, by one clinician or another, were said to have been mycosis fungoides. In most of these, autopsy findings with thorough histologic studies were available. The following observations seem pertinent. Among the 53 patients, there were 10 with systemic lymphoma of banal variety whose skin lesions showed no evidence of lymphoma at all, although they had been considered to be representative of mycosis fungoides. Twenty-one had systemic lymphoma of various types and isolated nodular tumors of the skin, lymphoma cutis. In 22 the lesion might be termed true mycosis fungoides histologically, with a picture not unlike that of granulomatous Hodgkin's disease. When these patients were examined more thoroughly, it was apparent that in 15 the disease was limited to the skin and no other organ or part of the body showed the process. Three showed skin lymphoma or mycosis fungoides with lymphatic leukemia and bone marrow alteration, two very different histologic patterns. Two showed skin and lymph node alteration alone, both with Hodgkin's-like structure. Two showed involvement of the skin, lymph nodes, and the viscera with this particular lesion. It would seem from this that mycosis fungoides is not necessarily one disease at all, when viewed clinically, but actually a group of disorders.

**Edwin Lame, M.D.** (Philadelphia): I have had the opportunity of working with Dr. Custer, a very great pleasure because his theory is most

useful to a radiotherapist. The principle deserves general recommendation. It teaches some most practical lessons:

(*a*) That one patient may have, simultaneously or in series, two or more varying lymphomatous lesions which are of the same origin and part of one disease.

(*b*) That an irregular behavior (varying course, response, and duration) may be expected within the limits of one patient's disease, dependent on time and the number of lesions, and also in the relation of one case to another.

(*c*) That there is a necessity of securing not one but perhaps multiple and serial biopsies in managing a single case.

The patient that first appears with a lump in his throat or neck, diagnosed as Hodgkin's granuloma, and in three or four months shows a gastric or colonic lesion, which is lymphosarcoma, and finally presents a bone marrow picture of lymphogenous leukemia, is the one who proves Dr. Custer's theory as a realistic, valuable working plan.

**Bernard Roswit, M.D.** (New York, N. Y.): I have seen and treated at the Kingsbridge Veterans Hospital in New York more than a thousand patients with malignant lymphomas in the last fifteen years. Since the publication of Jackson and Parker's monograph, we have tried to confirm their opinion that the clinical course and response to treatment followed their pattern of pathological differentiation. We have failed to find any such relationship. I would like to know what Dr. Custer thinks about the relationship between clinical course and the pathological type (paragranuloma, granuloma, sarcoma). We have on several occasions seen more than one type in the same patient, either at the same time or during the course of the disease.

**Henry S. Kaplan, M.D.** (San Francisco, Calif.): I hesitate to bring the mouse into the discussion, but I believe there is experimental confirmation for at least part of the transition which Dr. Custer has described. We and others who have worked with experimental lymphomas of the mouse have repeatedly observed transitions from frank lymphatic leukemia to localized or disseminated lymphosarcoma. And I believe that there is clear-cut evidence to indicate even more critically that the same tumor transplanted by different technics may give rise to these two forms of what appears to be the same disease. In essence, if one implants into a new host a fragment of such a tumor as an organized piece of tissue, it will usually grow as a solitary lymphosarcomatous mass, which may then metastasize. But if one takes the tumor, or fraction of the same tumor, and suspends it in saline, and injects it either intravenously or intraperitoneally, it is likely to make its appearance in the form of typical leukemia, with no evidence of tumefaction anywhere in the body.

One thing we have not seen as yet, however, is a connection between the lymphoma group, designating the lymphatic leukemias and lymphosarcomas together, and the Hodgkin's type of disease, which also does occur in the mouse. I wonder whether Doctor Custer feels that this part of the connection in his scheme is perhaps not more tenuous than the other part of the entire picture which we have seen experimentally; whether there might not perhaps be two kinds of lymphomatous disease, one based upon the lymphocyte and the other perhaps based upon the macrophage-monocyte series.

**Dr. Custer** (*closing*): Commenting on Doctor Gall's interpretation of this variable histologic pattern, I think it is a valid one, and certainly applicable to our patients, in whom we find at the same time two or three, sometimes more, histologic variants of lymphoma. I should perhaps use the term "transition" a little more carefully.

Regarding prognosis based on histologic patterns, I quite agree with the comments that have been made. I do not believe it possible, except in a very general way, to anticipate the duration of life or the response to therapy by the microscopic appearance of the tumor. We have had wide variations in survival and response to treatment in lymphomas presenting exactly the same appearance under the 'scope.

With respect to the animal tumors, I have not had enough experience with lymphoma in mice—although we have worked with it to some extent—to answer very clearly the question that was raised. I believe that in human lymphoma the interrelationships are even closer than they are in the mouse. The one bridge that we find most difficult to establish is between the lymphomatous tumors and granulocytic leukemia and its closely allied diseases.

# Radiation Necrosis of the Mandible[1]

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Seattle, Wash.

EVEN in the pioneer days of radiation therapy the problem of dental caries as a sequel to irradiation of lesions in the oral cavity existed. Despite technical advances and increasing experience, the problem persists. In many centers pre-treatment extraction of teeth has become an established procedure to avoid subsequent dental complications. Yet disastrous mandibular necrosis as a complication to extractions after irradiation was reported as late as 1952 (1).

Although bone has been considered relatively radioresistant, when it is in the region of a cancer it may be the limiting factor in the amount of radiation that can be delivered. In the oral cavity, a tooth-bearing bone in the treatment field provides an excellent mechanism for the introduction of infection and subsequent osteonecrosis if and when caries appears. After the vascularity of the bone has been compromised by irradiation, little response to bacterial invasion occurs, and the necrosis slowly progresses to involve the entire irradiated bony part, in patients who are otherwise free of disease. Case material from the Tumor Institute of the Swedish Hospital reported in this study will be analyzed to assess the value of pre-irradiation extraction of teeth, as a method of preventing not only post-irradiation caries and pain, but also the more disastrous complication of osteonecrosis of the mandible. A method of avoiding mandibular necrosis is suggested by this study, and its rationale will be developed.

## THE PROBLEM OF OSTEONECROSIS

Regaud reported on the complication of mandibular necrosis following irradiation as early as 1922 (2). He observed that it differed from typical osteomyelitis in that there was no line of demarcation between the dead and viable bone. When the unrelenting process had reached the boundary of the field of irradiation, the sequence of involucrum formation, sequestration, and healing proceeded in the ordinary fashion. He postulated that the loss of reactivity of bone compromised by irradiation was due to the decreased vascular reserve from endothelial proliferation. These observations are frequently substantiated today.

A review of 1,819 records of patients irradiated for cancer of the oral cavity was published by Watson and Scarborough of the Memorial Hospital (New York) in 1938 (3). They were unable, however, to state the percentage of these patients completing treatment, the amount of irradiation received by those who did, or their pre-treatment dental status. Consequently, the frequency figure for osteonecrosis based on this series—12.9 per cent of all patients accepted for irradiation therapy of intra-oral cancer—is of little aid in determining the responsible factors.

## IRRADIATED BONE

In 1950, McCrorie (4) postulated that the post-irradiation osteoporosis observed on roentgenographic studies resulted from unopposed osteoclastic activity, since microscopically he saw no surviving osteoblasts. He believed the lethal dose for osteoblasts was less than for osteoclasts, allowing for unopposed osteolysis in the unbalanced dynamics of bone metabolism.

Kritter, in 1949 (5), attributed the decalcification to a hyperemia produced by the irradiation. This view he based on the observations of Leriche and Policard, who found decalcification of bone whenever hyperemia of any origin was present. Sclerosis and calcification occurred with

[1] From the Tumor Institute of the Swedish Hospital, Seattle, Wash. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

the loss of blood supply. At first glance, this seems to agree with the cycle of vascular changes known to occur in other tissues. However, rather than occurring during the transient period of hyperemia immediately following irradiation, the osteoporosis continues long after the establishment of endarteritis.

Stampfli and Kerr (6) considered the osteoporosis to be due to *both* unopposed osteoclastic activity and hyperemia. Among three biopsies of post-irradiation osteoporosis, they found two with thinning of the trabeculae, no osteoblasts, and a few osteoclasts. In the third, from a patient in whom a fracture had been present for a year, normal trabeculation and no endarteritis were seen. Normal osteoblastic and osteoclastic equilibrium was established, indicating either recovery of these cells or their replacement from the histiocytes of repair.

Regaud (2) found complete endarteritis with death of the heavily irradiated bone. Barring the introduction of infection by continued presence of neoplasm or trauma, breaking the protective mucosal barrier, heavily irradiated dead bone will remain *in situ*, asymptomatic.

When the irradiated bone is a mandible, a specific problem exists, in that the teeth themselves are affected by x-rays. Clinically this effect is first manifested by pain on pressure, temperature change, and sweet and sour. Punctate caries is then seen in the single cusp teeth at the cemento-enamel junction (Figs. 2 and 7), leading finally to amputation of the tooth. In the multicusp teeth, whole cusps are lost (Fig. 3A).

As to the histologic findings, Cernea and Bataille (7) quoted Liest who, with irradiation, produced experimentally the same loss of demarcation between pulp and dentine seen in teeth removed after irradiation therapy. Microscopically, he saw osteoblasts with retracted nuclei and reticular atrophy of the pulp. There was a profusion of caries in the depth of the tooth, as well as on its surface surrounding the crown. This was caused by the observed vascular changes, degeneration of the odontoblasts, and fibrous changes of the pulp.

B. O. A. Thomas (8) considers post-irradiation caries indistinguishable from caries of any other origin, while the rapidity of development resembles that seen in a young child with congenital absence of saliva. Regato (9) also believes that changes in the saliva may produce the tooth necrosis seen, although he does not regard this as a simple *p*H effect, but rather as related to the lack of saliva and its protective bathing of the teeth.

Although occasionally generalized caries is seen after irradiation, in some patients the effect is seen first and only in the direct beam of intense irradiation. This would indicate that at least some phase of the caries is produced as a direct result of radiations on the teeth. For a detailed description of the changes beginning in the dentine and pulp and the clinical progression of the process through spontaneous amputation and alveolar abscesses, the reader is referred to the graphic descriptions of Cernea and Bataille and of Regato.

The management of irradiation osteonecrosis of the mandible has been a matter of disagreement. Usually, general physiological support and awaiting the elimination of the dead bone have been advised, though the patient is thus doomed to foul drainage and frequent fistula formation over a period of many years. This policy was supported by the report by Watson and Scarborough, in 1938, of 21.6 per cent mortality following resection of the mandible. With use of present-day antibiotics, anesthesia, and blood replacement, this mortality no longer stands.

Due to the nature of irradiation osteonecrosis, with loss of capacity to form an involucrum and limit the extent of the process, the necrosis must proceed to involve the entire area of compromised bone to obtain spontaneous healing. This is a prolonged and painful process. Regaud advocated cautery of the necrotic bone to hasten extension of the necrosis to the site of reactive bone and true in-

TABLE I: AUTHORS' SERIES

| Site of Neoplasm | Total | Acceptable for Study | Consultation after Treatment | Referred for Surgery | Unfit for Treatment | Less Than Minimum Requirements |
|---|---|---|---|---|---|---|
| Nasopharynx | 53 | 24 | 3 | 3 | 4 | 19 |
| Buccal mucosa | 38 | 15 | 9 | 9 | 4 | 1 |
| Floor of mouth | 16 | 4 | 2 | 3 | 3 | 4 |
| Tongue | 84 | 33 | 17 | 13 | 16 | 5 |
| Gingiva | 25 | 12 | 3 | 6 | 2 | 2 |
| Palate | 15 | 2 | 6 | 3 | 3 | 1 |
| Tonsil | 31 | 14 | 7 | 0 | 5 | 5 |
| TOTAL | 262 | 104 | 47 | 37 | 37 | 37 |

volucrum formation. The alternative is surgical excision of the irradiated portion of the mandible at the onset of osteonecrosis. This latter procedure is the shortest and, in modern surgical atmosphere, the treatment of choice.

## PATIENT MANAGEMENT

Of the methods of management of the patient with irradiation for cancer of the oral cavity, that of Coutard is most generally accepted. This was described in 1939 by Cutler, Buschke and Cantril (10), who stated that necrosis is usually the result of the triad of heavy irradiation, trauma, and infection, the latter two being frequently synergistic if not synonymous in effect. Considering infection the most important factor in the problem of mandibular necrosis, a contention supported and reiterated by Lawrence in 1946 (11), they regarded the removal of the teeth prior to irradiation as essential to circumvent mandibular complications. At that time, they were reluctant to advocate surgery for the elimination of necrotic bone after treatment. They felt that tooth extraction alone, after irradiation, was dangerous because it opened a portal of infection through the alveoli.

Paterson (12) wrote that necrosis was the result of radical treatment and could be avoided consistently only by undertreatment; that it must be expected and considered homologous to the operative mortality of the surgeon. He advised allowing the sequestrum to separate, since removal would cause an extension of the necrotic process. As to the teeth, he felt delay by pre-treatment extraction to be ill-advised and post-treatment extraction dangerous. Patients should be advised to retain their teeth in spite of the pain and disability.

Quick, in 1950 (13), observed that the elimination of all teeth prior to irradiation, whether or not they were carious, was more hazardous than their removal later, when proper oral hygiene allows for extraction under more ideal conditions. With this method of management, he advised Penicillin parenterally for oral sepsis. This is essentially as stated when he discussed a paper by Daland (1941), who had advised that all dental work be done prior to irradiation, with no extractions for many years (14).

## PRESENT STUDY

Two hundred and sixty-two patients were seen with intra-oral cancer between 1939 and 1951. The anatomic distribution of their disease and the reasons why 158 were not acceptable for this study are presented in Table I. Those judged unfit for treatment were rejected by reason of age, general debility, or distant metastases, making survival through therapy or palliation unlikely. The 37 patients in the last column were rejected because they received less than 4,000 r in the mandible, or survived less than six months after treatment. These minimums are chosen because it became evident that both a substantial dose and survival were necessary for production of osteonecrosis.

One hundred and four patients fulfilled the above criteria. While only 16 were

TABLE II: PATIENTS TREATED WITH TEETH IN DIRECT BEAM OF 800-KV. X-RAYS

| Age | Lesion | Roentgens in Mandible | Onset of Caries | Extraction | Survival |
|---|---|---|---|---|---|
| 29 | Carcinoma of nasopharynx | 7,000 r/29 days | 2 years | 13 years | 13 3/4 years |
| 44 | Lymphoepithelioma of nasopharynx | 6,800 r/29 days | None | | 30 months |
| 44 | Carcinoma of tonsil | 6,750 r/29 days | 2 months | 14 months | 4 years |
| 12 | Lymphoepithelioma of nasopharynx | 6,000 r/55 days | 5 years | 6 years | 6 3/4 years |
| 54 | Carcinoma of tonsil | 7,000 r/43 days | 3 months | 20 months | 13 years |
| 70 | Carcinoma of nasopharynx | 8,500 r/44 days | 6 months | 7 months | 18 months |

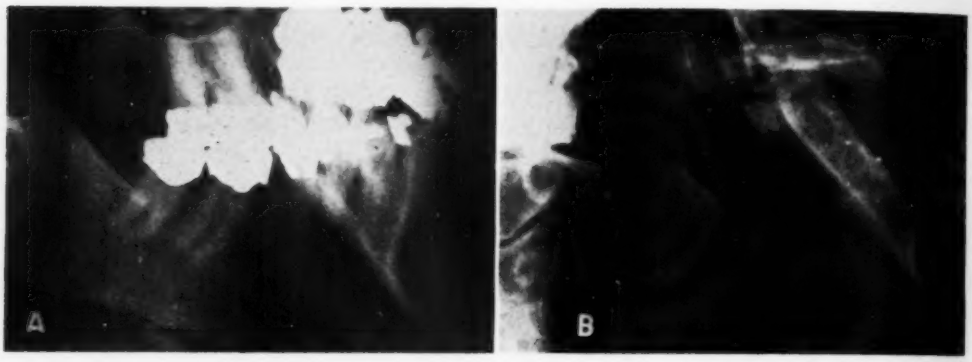


Fig. 1. Case I. A. Status after thirteen years of continuous dental repair following irradiation. All teeth were involved and the pain very severe.
B. Thirteen months after extraction of all teeth, with satisfactory healing.

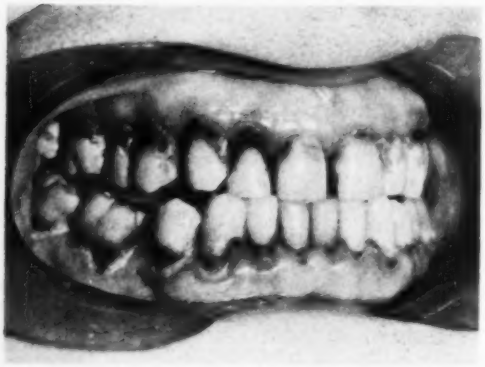

Fig. 2. Case III. Caries at the cemento-enamel junction characteristic of irradiation effect in single-cusp teeth. Prevention of this complication led to the concept of pre-irradiation extraction of all teeth.

below the age of fifty, 82 were less than sixty-five, meaning that more than 78 per cent of the carcinomas of the oral cavity occurred during the age of economic productivity. Sixty-nine per cent or 72 patients were already edentulous, so that the problem of management of the teeth occurred in only 31 per cent.

Thirty-two patients with teeth presented themselves for treatment. Seven, for various reasons indicated in the following case studies, were treated without preliminary extractions (see Table II).

CASE I: In 1939, a 29-year-old female with advanced cancer of the nasopharynx received 7,500 r in twenty-nine days, with 800 kv., at the level of the ascending ramus and the posterior one-fourth of the adjacent horizontal ramus on the left. Within two years teeth in and out of the direct beam of irradiation showed neck caries and numerous occlusal surface defects, but there was no damage to the mandible itself as late as January 1952 (Fig. 1A). In June 1952, the long heroic attempts to preserve these teeth were discontinued, and they were all removed with extreme care and high-level Penicillin coverage. A small piece of necrotic alveolar bone was extracted with the second molar of the left mandible. However, mucosal healing was complete in one month (Fig. 1B).

CASE II: In 1946, at the age of 44, a man was seen with destruction of the base of the skull from carcinoma of the nasopharynx. He was considered unlikely to survive long enough for necrosis of the mandible to develop. His treatment consisted of 6,800 r in twenty-nine days, with 800 kv., at the level of the ascending and posterior one-fourth of the horizontal rami bilaterally. A late mucosal reaction

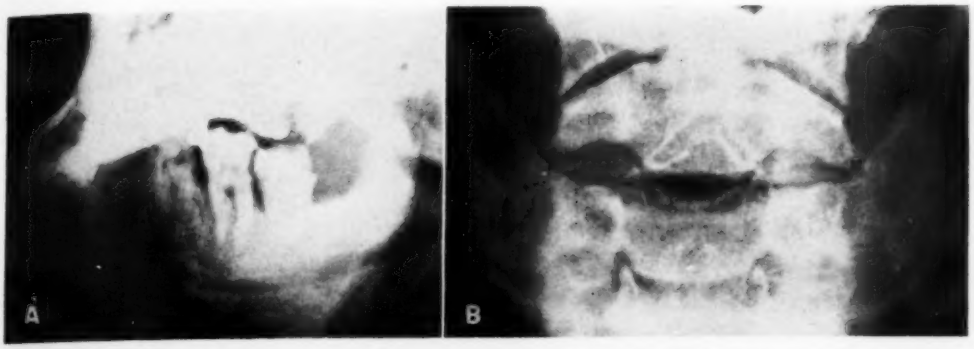


Fig. 3. Case III. A. Status fourteen months after radiation therapy. Note the loss of portion of the third molars characteristic of radiation damage in molars.
B. Perfect reconstruction of alveolar ridges following extractions performed fourteen months after irradiation.

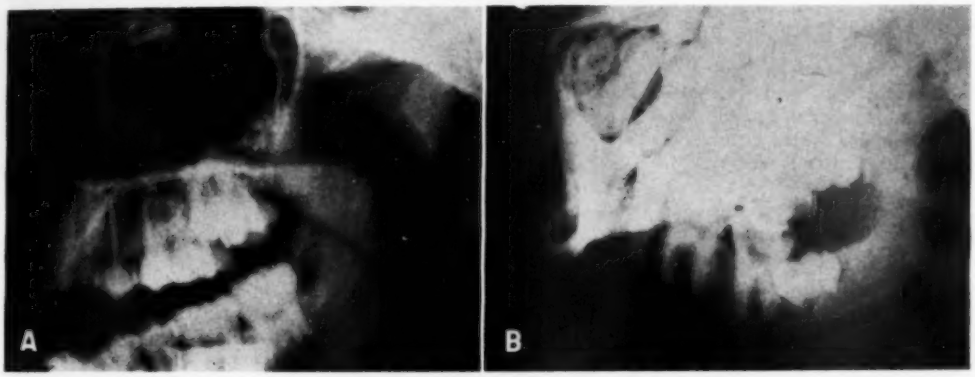


Fig. 4. Case IV. A. Dental status at the time of radiation therapy.
B. Necrosis of the second molar, but with normal development of the adjacent unerupted third molar.

appeared in eighteen months. There was no evidence of osteonecrosis of the mandible or dental injury at the time of death one year later.

CASE III: A 44-year-old male with extensive carcinoma of the tonsil and cervical metastases was seen in 1948 and treated with 800-kv. x-rays for a dose of 6,750 r in twenty-nine days to all but the anterior half of the left mandible. Within two months he complained of pain in the teeth. Caries at the cemento-enamel junction of the teeth was found and treated by fillings (Fig. 2). Fourteen months after treatment it was necessary to remove all teeth due to caries and pain, and this was accomplished with the aid of extensive antibiotic therapy (Fig. 3A). There has been no necrosis of the mandible to date. The excellent healing of the alveoli following extraction (Fig. 3B) is significant.

CASE IV: A 12-year-old boy was seen in 1946 with a massive nasopharyngeal cancer and received 6,000 r in fifty-five days to the posterior half of the horizontal and ascending rami of the mandible bilaterally, with 800 kv. Five years later there was severe necrosis of the molars, which were in the direct beam of x-ray. How early the necrosis had appeared is unknown because the patient was lost to follow-up for three years during this period. The remaining teeth showed no caries, and there was no evidence of osteonecrosis. During this time it is interesting to note the normal development of the unerupted third molar on the right (Figs. 4A and B). The unerupted tooth and necrotic molars have recently been removed, with extensive antibiotic medication, without difficulty.

CASE V: A 54-year-old female was treated in 1940 for extensive squamous-cell carcinoma of the right tonsil extending into the vallecula, across the base of the tongue, displacing the anterior pillar. Her survival long enough for osteonecrosis of the mandible to develop was considered unlikely. She received 7,000 r in the mandible in forty-three days, with 800 kv. In three months, after good healing of the primary mucosal reaction, necrosis of the molars with pain to sweet and sour, and on chewing, became a problem. Fourteen months later there was necro-

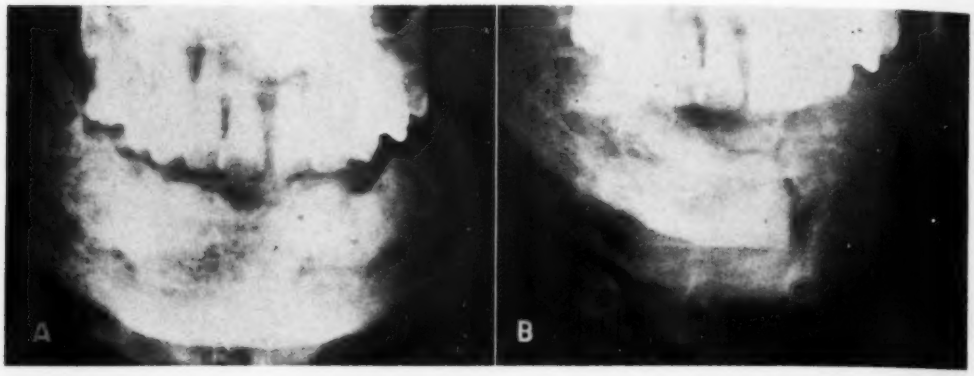


Fig. 5. Case VIII. A. Necrosis of the persistent alveoli fourteen months after irradiation in the left mandible, but normal healing on the right.
B. Well healed resected ends of mandible after removal of all irradiated bone.

sis of the right premolar, canine, and lateral incisors. Later, because of corneal ulceration thought to be related to the infected teeth, these were extracted and the gingiva healed within one week. This took place in 1941 without modern antibiotic medication but with extraordinary oral hygiene. The patient died in 1942, twenty months after treatment, from hemorrhage of the common carotid into a necrotic tumor mass in the neck.

CASE VI: A 70-year-old Negro with cancer of the right side of the nasopharynx in 1948 received 8,500 r in forty-four days, with 800 kv., to the right mandible, and 7,200 r to the left mandible. In six months the right molars showed extensive necrosis and these were removed under Penicillin therapy without difficulty. Healing occurred without delay. The teeth in the left mandible remained free of caries until death one year later. The differential dose of x-rays between the carious and the free molars of the mandible was 1,300 r. There was no necrosis of the mandible.

CASE VII: In 1942, a 28-year-old female was treated with interstitial radium to a dose of 6,500 r in one hundred and sixty-eight hours to a squamous-cell carcinoma in the left posterior border of the tongue. The adjacent gingiva and surface of the mandible received 6,000 r. The adjacent molars and mandible showed no changes in the five years before the patient died from lung metastases.

*Thus, in 5 of 7 patients with teeth remaining in the direct field of irradiation, caries developed, making extractions necessary because of unbearable pain. In none did this proceed to osteonecrosis of the mandible even when the teeth were removed years after the irradiation.*

*Prophylactic extractions* of all teeth, or at least those in the area of high dosage, were performed in 25 patients. The mucosa healed in seven to sixteen days and therapy was begun.

Seven patients were treated with radium: 2 by moulage and 5 with interstitial needles in the tongue. In the latter, the irradiation on the inner surface of the mandible, immediately adjacent to the implanted lesion, was in excess of 5,000 r in one hundred and forty hours. There was no mandibular necrosis, although one patient had necrosis of the soft tissues of the tongue. The 2 patients treated with moulage received more irradiation than the interstitially treated patients, but it was protracted, with periods of no irradiation interposed.

Four patients with cancer of the tongue were treated with combined x-ray and radium therapy, receiving 6,000 r *in the tongue* in twenty-two to twenty-seven days, with 800-kv. external irradiation. This was followed by interstitial radium, 5,000 r in one hundred and forty hours on the average, without resultant necrosis of the mandible.

Fourteen patients received roentgen therapy, 12 of these with 800 kv. and doses in the mandible ranging from 5,000 r in fourteen days to 8,000 r in twenty-three days. Two were treated at conventional voltages; one of these with transoral cone. Six were free of mandibular complications,

TABLE III: PATIENTS RECEIVING EXTERNAL ROENTGEN THERAPY AFTER PROPHYLACTIC EXTRACTIONS

| Patients With Osteonecrosis of Mandible | | | | Patients Without Osteonecrosis of Mandible | | | |
|---|---|---|---|---|---|---|---|
| Age | Site of Cancer | Extraction before Treatment | Roentgens in Mandible | Age | Site of Cancer | Extraction before Treatment | Roentgens in Mandible |
| 53 | Gingiva | 10 days | 6,300 r/63 days | 74 | Buccal | 21 days | 6,300 r/26 days |
| 54 | Buccal | 14 days | 6,200 r/24 days | 63 | Gingiva | 15 days | 5,900 r/19 days |
| 62 | Buccal | 8 days | 5,800 r/32 days | 70 | Buccal | 14 days | 5,400 r/32 days |
| 51 | Lip and gingiva | 14 days | 5,400 r/35 days | 69 | Tonsil | 14 days | 5,400 r/28 days |
| 54 | Buccal | 5 days | 5,100 r/28 days | 52 | Buccal | 14 days | 4,950 r/26 days |
| 73 | Floor of mouth | 10 days | 4,100 r/14 days | 72 | Gingiva | 14 days | 4,500 r/14 days |

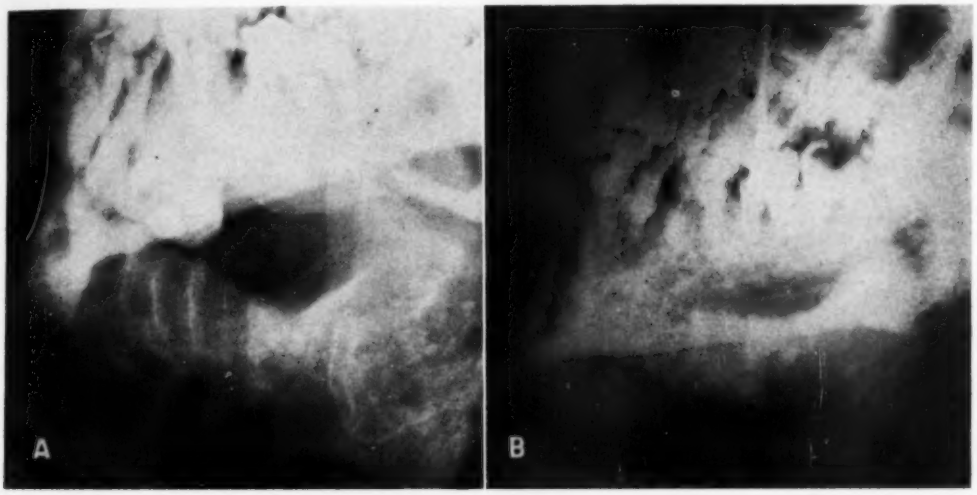


Fig. 6. Case IX. A. Persistence of unhealed alveoli twenty months after irradiation. B. Progressive mandibular necrosis anteriorly after numerous sequestrations.

and 2 died without primary healing of their lesions and with progressive mandibular necrosis and tumor. In 6 there was complete healing after treatment, with subsequent development of caries and necrosis of the mandible (see Table III).

CASE VIII: In 1948, a 53-year-old male with squamous-cell carcinoma of the gingival mucosa and adjacent sulcus was treated ten days after removal of teeth adjacent to the lesion. He was given 1,800 r externally in twenty-one days with 400 kv., followed by 5,000 r transorally with 200 kv. in forty-two days. He thus received, over sixty-three days, 5,800 r to the mandible. Primary healing occurred only to be interrupted in three months by extrusion of a spicule of alveolar bone from the treated area. This progressed, with denudation of the left mandible (Fig. 5A). Two sequestrectomy procedures were done, but finally radical resection of the mandible was performed two and a half years after treatment (Fig. 5B). To date this patient is alive and well, free of disease, and with good function of the mandible.

CASE IX: In 1943, a 73-year-old male with a squamous-cell carcinoma of the floor of the mouth, 3 cm. in diameter, submitted to extractions of numerous carious teeth adjacent to the lesion, ten days prior to irradiation therapy. A modest treatment for palliation was carried out—4,625 r (skin dose) in fourteen days with 400 kv. A desquamative mucosal reaction developed, with healing in two months. Sixteen months later a small spicule of bone was removed from the mandible and a draining sinus ensued; x-ray examination did not show mandibular remodeling (Fig. 6A). In nineteen months, 3 cm. of the mandible were exposed and mandibular necrosis was demonstrated roentgenologically. The patient was cautioned against manipulation but persuaded his dentist to remove the exposed bone (Fig. 6B). Further necrosis and a skin sinus resulted. The patient died seven months later without the benefit of mandibular resection and with unhealed necrosis. He had survived thirty-

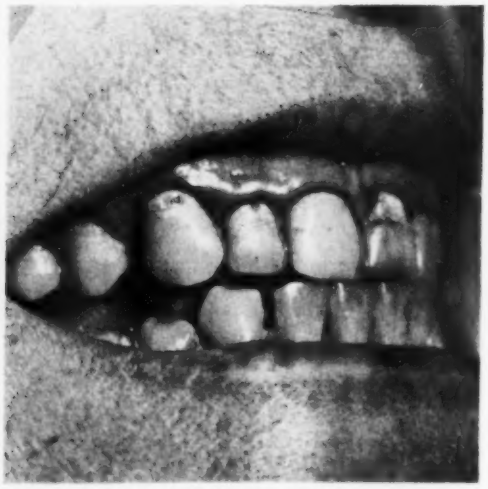

Fig. 7. Case X. Early punctate caries at the cemento-enamel junction beginning four months after irradiation. The teeth in the direct beam of radiation had been extracted prior to therapy.

seven months after the completion of treatment, spending more than nineteen months with necrotic drainage and exposed necrotic bone in the mouth. This is not an unusually long period of time when the method of spontaneous resolution is pursued.

## Four other patients of interest are of the group of 12 treated with 800 kv. radiation, externally.

CASE X: In 1946, a 54-year-old female was accepted for treatment with a 2-cm. ulcerated squamous-cell carcinoma of the buccal mucosa just anterior to the left vertical ramus of the mandible. Prior to irradiation the four upper posterior teeth and three lower molars on the left were extracted. Nine days later x-ray therapy was begun, for a dose of 5,700 r in twenty-eight days, with 800 kv., to the mandible through one field. There was a mucosal defect in the area of extraction of the third molar inferiorly throughout the treatment period and until twelve weeks later, when there was a spontaneous sequestration of the exposed bone with complete re-epithelialization. The patient was well until one year later, when pain occurred in all remaining teeth, with numerous superficial defects at the cemento-enamel junction (Fig. 7). Sixteen months post-treatment a recurrence in the mucosa of the cheek was excised, only to reappear in four months, with lymphadenopathy. Twenty-six months after the completion of the original treatment, resection of the mandible and plastic repair of the cheek were performed. Extensive necrosis of the mandible complicated by persistent carcinoma in the mucosa immediately adjacent was found in the surgical specimen. Subsequent survival was brief.

CASE XI: In 1950, a 51-year-old male with an extensive cancer of the entire lower lip, except for the left commissure, was accepted for treatment. The lesion measured 5.5 cm. in length and there was a 2-cm. nodular infiltration in the region of the right commissure. Right submaxillary and submental lymph nodes were involved. The lower teeth were extracted prior to therapy (Fig. 8). Treatment consisted of 4,450 r in twenty days with 800 kv., which

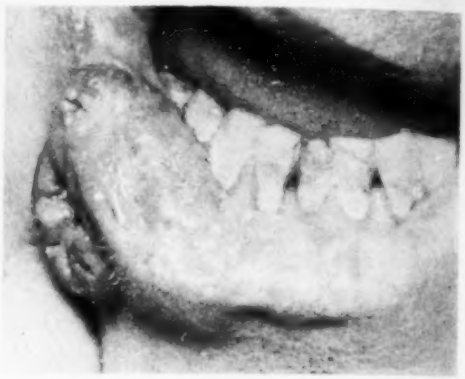

Fig. 8. Case XI. Extensive cancer of the lip.

resulted in extensive reaction of the entire oral cavity. Fourteen days later, additional therapy was begun, 1,600 r being given with 200 kv., in four days. Lead-rubber protection of the tissues behind the lip was possible with this kilovoltage. One month later a neck dissection was performed. Ten months after treatment the right anterior alveolar ridge was exposed. Roentgenograms obtained one year later showed absence of reconstruction of the mandible (Fig. 9A). Four months after this, the area of the mandible containing the sequestrum was excised. The inferior margin of the mandible was allowed to remain, since it was known not to have been included in the field of irradiation. Healing was prompt, and there has been no evidence of further necrosis to date (Fig. 9B). This very well demonstrates the principle of avoiding complications by carrying the surgery well outside the margins of the field of irradiation.

CASE XII: A male, 62 years old, in 1948 presented himself with cancer 1.5 cm. in diameter involving the left posterior gingival mucosa. He reported that an ulcer had persisted approximately two years following extraction of a tooth. Just before admission the second molar adjacent to the ulceration began to be painful, as the lesion extended to surround it. This tooth was extracted prior to x-ray therapy, which consisted of 6,500 r in thirty-two days to the right mandibular area, delivered with 800 kv. through one field. Five and a half months after treatment there was extensive necrosis of the mandible. The patient escaped the fate of mandibu-

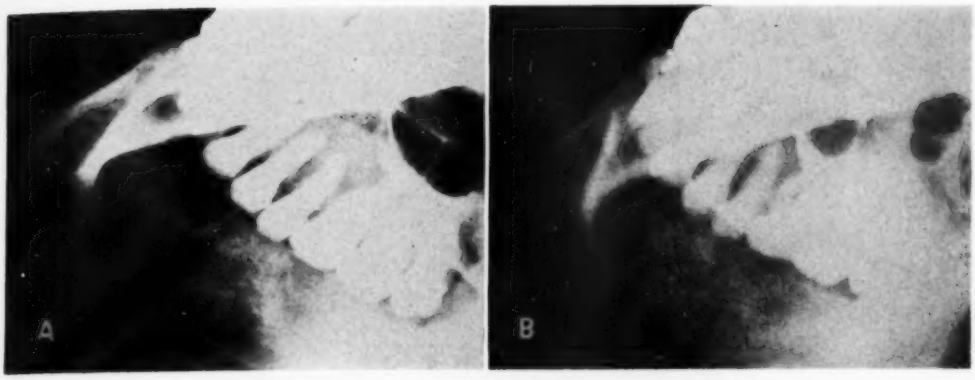


Fig. 9. Case XI. A. Ten months after irradiation, showing sequestrum and unhealed alveoli. B. Well healed mandible after resection of the irradiated portion of the bone.

lar necrosis or radical resection when he succumbed to metastases from a carcinoma of the rectum ten months after treatment.

CASE XIII: The most interesting patient of this group is a 54-year-old female who was first seen in 1943 after extraction of the third molar, lower left, because of an adjacent ulcer. The lesion was a squamous-cell carcinoma and had extended into the sulcus from the gingiva. There was no lymphadenopathy (Fig. 10A). One week after extraction of the remaining lower teeth, the patient began treatment, which was completed twenty-four days later, when she had received 6,200 r in the left mandible, with 800 kv., through one field. Healing was complete and remained so for two years. In April 1945, she returned with a mucosal defect at the site of the original lesion, after wearing a denture for one month. The persistence of spear-like alveolar processes, two years after the extraction of teeth, is seen in Fig. 10B. By November the defect had progressed further, without the use of the denture, to expose 3 mm. of bone. Fourteen months later roentgenograms showed necrosis of the mandible and the first spontaneous sequestration occurred (Fig. 10D). There was surprisingly little pain. Necrosis and sequestration continued through September 1948, but in June 1949 a hematoma was produced in the cheek by an automobile accident. The hematoma sloughed rather than organized, and by March 1950, ten months later, it had progressed to produce a buccal fistula with exposure of the mandible. Following a sneeze, two months later, a fracture occurred, with no evidence of healing in six months (Fig. 10E). At this time, November 1950, resection of the cheek and mandible with reconstruction of the face by pedicle graft was begun. Four months later this was completed but the deformity was out of proportion to that necessary had the procedure been done when the necrosis originally appeared (Fig. 11).

Seventy-two patients were completely edentulous with well-healed gums and had no extractions less than three months previous to treatment. Under ordinary circumstances these patients can be treated with either radium or x-ray therapy to an adequate dose for control of the tumor without danger of osteonecrosis. However, with overtreatment and excessive trauma, necrosis involving bone may occur anywhere. This was demonstrated by a 60-year-old male with extensive carcinoma of the buccal mucosa extending through the skin of the cheek. He received 3,000 r in forty-one days without complications until a large hematoma of the cheek occurred after an automobile accident. This broke down, and the maxilla sloughed entirely. The mandible, however, which received the same dose of radiation but was not involved in the hematoma, was spared.

In 9 of the edentulous patients mucosal necrosis developed after primary healing of the lesion. One had been treated by interstitial needles in the tongue with a tumor dose of 6,000 r in one hundred and twelve hours. Two received 200-kv. transoral cone therapy, 6,000 r in eighteen days and 5,950 r in twenty-three days. The remaining 6 were treated by external irradiation with 800 kv., with doses ranging from 4,800 r in nineteen days to 7,350 r in twenty-nine days in the area of tissue breakdown. In no instance was there progression to osteonecrosis of the irra-

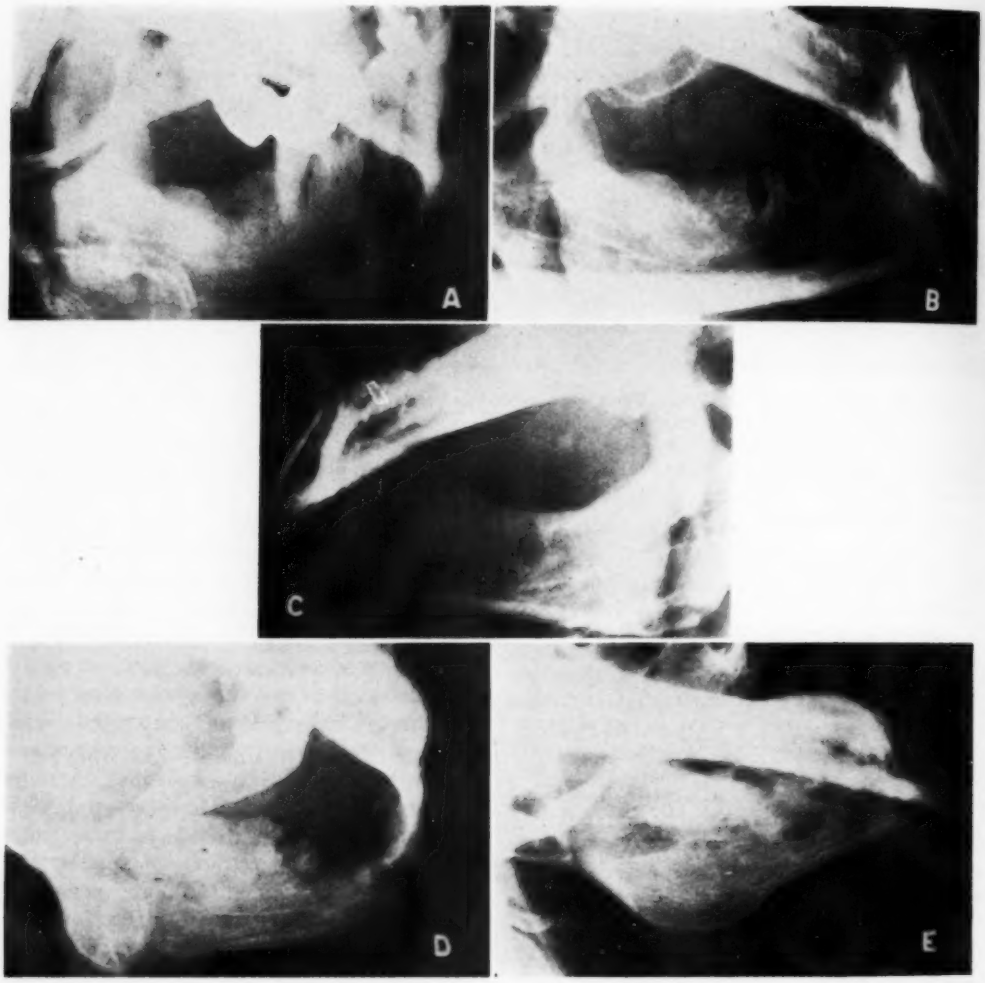


Fig. 10. Case XIII. Pre-irradiation extraction.
A. Status prior to radiation therapy.
B. Unhealed left mandible two years after irradiation, with sequestrum and preserved alveoli.
C. Unirradiated right mandible at the same date, with normal healing.
D. Few years after irradiation and continuous necrosis and sequestration.
E. Status prior to surgery six months after fracture.

diated mandible, and in all healing occurred within four months.

## DISCUSSION AND SUMMARY

Four groups of patients should be considered in the management of cancer of the oral cavity by radiation therapy.

1. The *edentulous patient* who has had sufficient time for reconstruction of the mandible prior to irradiation is safe from mandibular necrosis by virtue of the absence of the usual mechanism of introduction of infection through dental caries. In 9 of 72 such patients late mucosal necrosis developed but without progression to osteonecrosis of the mandible.

2. *Patients treated with radium* are usually spared necrosis of bone by virtue of the short range of the effective radiations. Considering the average thickness

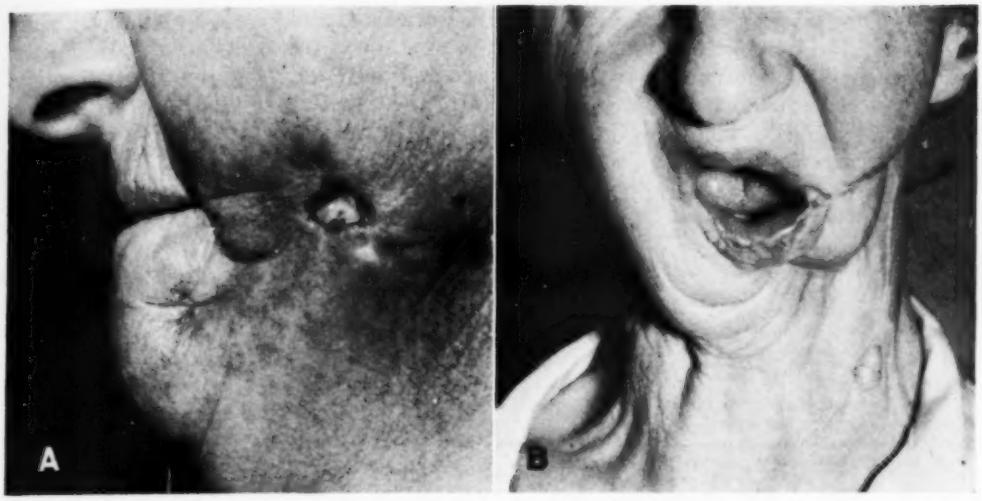


Fig. 11. Case XIII (shown also in Fig. 10). A. Patient just prior to surgery. Note brawny atrophy of the tissue about the fistula.
B. Status after reconstruction and pedicle graft, which ended the years of morbidity. The functional result is acceptable but cosmetically leaves much to be desired.

of the mandible to be approximately 1.0 cm., by geometric distribution of the radiations of radium, the dose on the side opposite the applicator is insufficient to cause irreparable damage to the vascular tissues. The inferior margin of the mandible also receives a negligible amount of radiation. Hence, there is absence of osteonecrosis even with soft-tissue necrosis, as only the immediately underlying surface of the mandible receives a necrosing dose. This is further demonstrated by the necrosis of the hard palate seen in a patient treated elsewhere with interstitial needles. The dose was adequate to control the tumor but not excessive. Yet in a year and a half necrosis and fistula formation resulted, since the entire diameter of the thin palatal bone received the high dose of radiation.

3. In *patients treated with teeth remaining* in the field of intense irradiation, the teeth may be removed subsequently with proper support and caution. In 7 patients this procedure was carried out for various reasons. In 5 of the 6 treated with roentgen therapy subsequent caries of the teeth developed. All finally required extractions. The procedure was carried out from months to years after the treatment and there was no single instance of osteonecrosis of the mandible. The remaining patient treated with teeth *in situ* was in the radium group considered above.

4. The last group to be considered involves those managed by *extraction of the teeth prior to roentgen therapy* to prevent caries. Only in this group of 14 patients did osteonecrosis of the mandible occur. Two patients did not obtain primary healing of their disease, and there was continuous progression, with mandibular necrosis, to death. Six of 12 patients with primary healing had osteonecrosis of the mandible. In extent of disease, protraction of treatment, and dosage, there was little difference between those who developed necrosis and those who did not (Table III). It should be pointed out that the apparent occurrence of mandibular necrosis in those with less than a fourteen-day healing period before irradiation was begun, can be misleading, particularly in a bar graph (Fig. 12). Close inspection, however, shows 7 of 12 patients falling into the indeterminate period in the middle, with only one over fifteen days.

The key factor will be noted in the x-ray studies submitted. In those patients

treated shortly after the extraction of teeth, the alveoli and their thin walls of bone remain intact for years, with sharp spicules ready to puncture the overlying protective mucosa. That this is due to a portal of infection to the underlying bone. When the teeth are removed after irradiation therapy, normal reconstruction of the mandible occurs, as in Figures 1B and 3B. This problem is well known

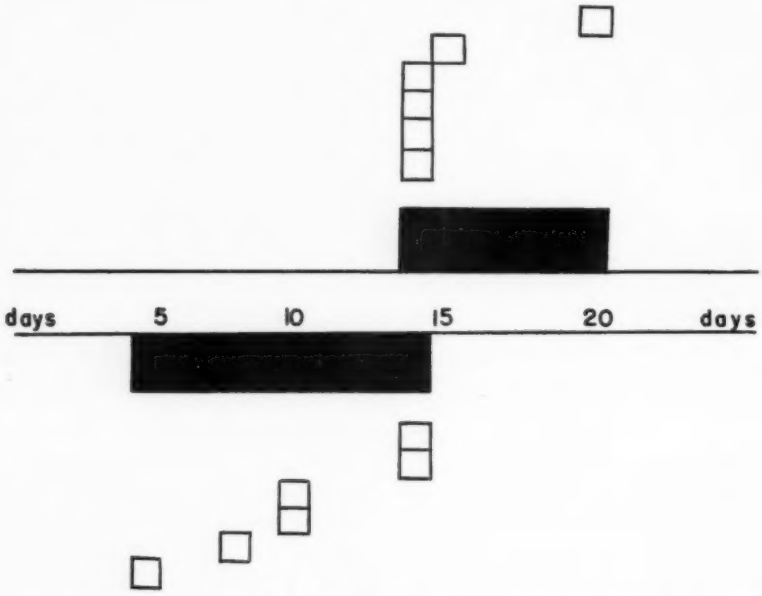


Fig. 12. Considering distribution in time of extraction before irradiation, one could conclude that there is danger of necrosis only when patients started radiation therapy less than fifteen days after extraction of the teeth. The aggregation of most of the presented small group of patients in the central indeterminate zone reduces the significance of the observation.

radiations absorbed is conclusively demonstrated by comparison of the left and right sides of the mandible as shown in Figures 10B and C. The former received irradiation and the alveoli are well demonstrated two years later, while the opposite side healed. Any pressure obviously results in the production of an avenue of bacterial invasion into the compromised underlying mandible (Figs. 5A, 6A, 7A, 10B). Again, spicules of bone fractured and separated from the mandible during the extraction are not allowed to heal or to be absorbed, due to the effect of the x-rays on granulation tissue. As a result, they die and become foreign bodies to be extruded as post-irradiation healing occurs. This also results in mucosal ulceration and to general radiologists and is discussed fully by Worth under the heading of "impaired remodeling" (15).

Thus, when irradiation is applied to the mandible rendered edentulous prior to treatment as a prophylaxis for later painful caries, the resultant delayed reconstruction leaves a mechanism of mucosal puncture and subsequent portal of infection more dangerous than the carious teeth which prophylactic extraction hoped to avoid. With modern medical management, the teeth can be safely extracted when they become troublesome, and the mandible will heal.

A statistical summary showing the results of treatment in the series of 104 cases is given in Table IV.

TABLE IV: STUDY OF 104 PATIENTS

| 72 Without Teeth at First Visit | 32 With Teeth at First Visit | |
|---|---|---|
| | 25 Preparatory Extractions | 7 Treated with Teeth |
| 9 late mucosal reactions<br>1 osteonecrosis from traumatic hematoma | 7 treated with radium; no necrosis<br>4 treated with radium and x-ray; no necrosis<br>14 treated with external x-ray<br>2 with progressive disease after treatment<br>6 free of necrosis<br>6 osteonecrosis of mandible | 2 with no caries<br>5 carious teeth extracted without osteonecrosis |

## CONCLUSION

Irradiation before reconstruction of the alveolar ridge of the mandible after prophylactic extraction of the teeth in the field of irradiation results in permanently delayed remodeling of the mandible and a persistent threat to the integrity of the overlying protective gingival mucosa. Reconstruction of the mandible occurs normally in those in whom the teeth are removed even several months to years after completion of radiation therapy. Therefore, with modern antibiotics and meticulous care, the teeth can be extracted when and if they become painful and carious after treatment, and the group of patients in whom osteonecrosis of the mandible occurs can in large measure be avoided.

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## SUMARIO

### Necrosis Mandibular por Irradiacion

Los protocolos del Hospital Sueco de Seattle, Wásh., E. U. A., han sido analizados para justipreciar el valor de la extracción pre-irradiación de los dientes como medio de impedir no sólo la caries y el dolor consecutivos a la irradiación, sino también la complicación más desastrosa de necrosis del maxilar inferior en casos de cáncer de la boca.

Forman la base de este estudio 104 casos: 32 enfermos tenían dientes cuando se presentaron para tratamiento y 72 eran desdentados. A 7 del primer grupo se les trató sin extracción preliminar de los dientes. En 5 de ellos, resultó después necesaria la extracción debido a la aparición de caries con dolor intenso, pero en ninguno se presentó necrosis del maxilar

después de la irradiación. En los 25 casos restantes, se ejecutaron extracciones profilácticas. El tratamiento subsiguiente fué con radio en 7 casos, con una combinación de roentgeno y curieterapia (por carcinoma de la lengua) en 4 y con la roentgenoterapia sola en 14. En 6 enfermos, todos los cuales habían recibido roentgenoterapia, se presentaron después caries y necrosis.

Esas observaciones llevan a los AA. a la conclusión de que, cuando se aplica irradiación a una mandíbula edentulizada antes del tratamiento, con el objeto de impedir más tarde una caries dolorosa, la consiguiente demora en la reconstrucción del surco alveolar constituye una amenaza persistente a la integridad de la mucosa que protege la encía, ofreciendo después una vía de entrada a la infección, que es más peligrosa que la caries dental que trataba de impedir la extracción. Con la moderna asistencia médica, pueden extraerse inocuamente los dientes cuando molesten y la mandíbula sanará normalmente.

## DISCUSSION

**J. E. Miller, M.D.** (Dallas, Texas): I think Doctors Wildermuth and Cantril are to be congratulated on this paper, and I think it rates more than a superficial reading. It could well be studied in detail by individuals faced with this problem.

I have considered three factors as being the cause of osteonecrosis following irradiation. There is very little doubt that the endarteritis resulting from irradiation is an important factor. The unopposed osteoclastic activity which is known to result certainly seems logically to play a significant role. This is based on the observation that the lethal dose of irradiation to osteoblasts is less than for osteoclasts. I see no reason to consider hyperemia as an important cause of the decalcification seen or the necroses resulting from irradiation. There is, of course, no question about trauma and infection being most important. I notice that in two of the essayists' cases trauma as a result of an automobile accident was probably a direct cause of the breakdown of the tissues. I have known for quite a while that cars were dangerous, but this is a new danger that I must add.

With regard to tooth necrosis, I have considered the direct irradiation of the teeth as well as the changes in saliva, and especially diminution in saliva, to be important factors.

It is difficult for me to see how anyone can advocate waiting for the natural elimination of the dead bone in irradiation necrosis. While this may doom the patient to foul drainage and fistula formation, the pain of the condition is of paramount importance. Anyone who himself has experienced severe pain for a long period of time would probably not advocate this policy. If your consulting surgeons have adequate experience in the treatment of neoplasms, this problem can be cared for efficiently and without prejudicing to any great extent the irradiation method of treatment of cancer of the head and neck.

I certainly agree with the authors that the surgical excision of the irradiated portion of the mandible at the beginning of the osteonecrosis is the preferable method of treatment. I would like to stress removal of the necrotic portion of the mandible, since many surgeons do more radical procedures that leave considerable deformity which is not necessary. If radium alone has been used in the treatment of the neoplasm, it is possible to remove only a portion of the mandible, leaving a bridge of bone which will preserve the contour of the face.

In reviewing the authors' cases which were treated without preliminary extraction, it is noted that, in the one patient treated with interstitial radium left in place for one hundred and sixty-eight hours, there was no trouble with the adjacent mandible or the molar teeth. One hundred sixty-eight hours is a magic time, since most of us in Dallas follow Dr. Charles Martin's technic of using low-intensity radium needles in the treatment of neoplasms around the head and neck. Those of us whose preliminary training was predominantly with roentgen irradiation for such neoplasms, and high-intensity irradiation when radium was used, are struck with the diminution of complications with low-intensity radium and an increased time factor in administering the irradiation therapy.

Those of us who have de-emphasized the use of external irradiation are not familiar with the necrosis of the teeth which the authors speak of in this group of cases. I think it is particularly important to note that teeth can be removed without difficulty if this is done at the proper time and with care. It is difficult for me to remember how long ago I was instrumental in having teeth removed before irradiation. It must have been three or four years, anyway. We leave the teeth in now, and remove them afterward.

This paper by Dr. Wildermuth and Dr. Cantril makes two points which I would like to stress, in conclusion. First, that teeth need not be removed. I think the authors imply, or even so

much as say, that they should not be removed, before irradiation. The important contribution they make is that teeth can be removed subsequently without the difficulty which I thought some ten years ago would be inevitable. And, of course, one thing they said, which I would particularly like to stress, is the safety of low-intensity radium.

**Juan A. del Regato, M.D.** (Colorado Springs, Colo.): Necrosis of the mandible following intensive irradiation of tumors of the oral cavity has been observed since the early days of curietherapy. The presence of teeth in bad condition, constituting a portal of entry to infection of the heavily irradiated bone, was considered as an additional contributing factor. Extraction of teeth following irradiation was held to be dangerous since by that time the bone has become devitalized; this led to pre-irradiation extraction as a precautionary measure.

In 1934, we made our first observations of the fact that, following irradiation of the oral cavity or pharynx, peculiar painless caries of the teeth occurred which destroyed them and reduced them to simple roots imbedded in the alveoli. We first thought that these lesions occurred because of direct irradiation of the teeth, but later concluded that they were the result of the indirect effect of radiations on the salivary glands (Am. J. Roentgeol. **42**: 404–410, 1939). Consequently, even when the teeth were in good condition, the possibility of them becoming a portal of entry for constant infection from the oral cavity was always there. For this reason, in 1937 we started to advocate the prophylactic extraction of teeth regardless of their condition before radiotherapy of tumors of the oral cavity and oropharynx was instituted. Dr. Cantril was one of our early converts to this point of view; this paper would appear to be a reversal of his convictions. Actually, there are here several factors to take into consideration. First of all, one does not need to irradiate immediately after extraction of teeth. A reasonable interval may be allowed to lapse. Second, the intensity of the irradiation is another important factor. In recent years we have protracted our treatments much more than previously, and we find that the risk of bone necrosis and the dangers attendant upon extractions are not as great as when intense irradiation is done.

I believe that the authors of this paper exaggerate when they incriminate the extraction as the cause of the subsequent necrosis. Most of their treatments were done in a short number of days, rather intensively, and this must also be taken into consideration. We can only conclude that, where patients are irradiated in this fashion, the prophylactic extraction results too often in bone necrosis; this does not necessarily apply when the technic of treatment is less intensive.

**John Walker, M.D.** (Seattle, Wash.): Dr. del Regato brought out the effect of intense irradiation on the salivary gland, and I wish to reemphasize that. I am sure that is one of the reasons for the development of annular caries.

I would like to ask Dr. Wildermuth whether in those cases which did have extraction, dental radiographic examination was done. We all know that dentists—good and bad—leave retained fragments, and retained fragments have a habit of coming out. If they are left and do extrude, certainly they are an avenue for infection.

One who does radiation therapy, if he believes in prior extraction, should have a dentist in whom he has confidence, and who knows the problem of intra-oral carcinoma. We always examine the mandible following extraction. By that you can infer that we do remove our patients' teeth prior to irradiation. I think we will probably continue to do so, because we don't have quite the number of complications that the essayists have reported.

**Dr. Wildermuth** (*closing*): As to the remarks of Doctor Regato, I am reminded of medical school in Cincinnati, where once in a brash moment, as a student, I attempted to tell an orthopedic surgeon something I had learned out of the literature. After letting me rant and rave, he asked me if I would really try to teach my grandmother to suck eggs. For this reason, I don't believe I will comment on Doctor Regato's remarks except to say that in the final text of this paper I do refer to his work. I would also like to say that, if he will recall Table III, in which we compared two groups of patients, the 50 per cent who got necrosis and the 50 per cent who did not, he will note that there was no difference in either the disease, the amount of treatment, or time of extraction. So, if it is done in this fashion, there is a 50 per cent chance of getting necrosis of the mandible. I wish to emphasize that in those patients whom we have examined, we have found this very definite characteristic change of preserved alveoli years after treatment, when, under ordinary circumstances, the alveoli were all filled in, giving a nice, smooth margin of bone.

In one of the 72 edentulous patients, the alveolar ridge became exposed, but because of the well eburnated margin, mucosal healing occurred over the bone. The delayed reconstruction, which is well discussed in *British Authors* by Worth, is a concept that was new to me when I stumbled on it. I think it deserves more consideration. We are following Doctor Walker's suggestion, and the patients who have been treated after extractions are having frequent examinations of the mandible to demonstrate alveolar changes. It is remarkable that there will be smudging of the alveolar septa before the rupture of the mucosa and sequestration which will finally go on to necrosis.

# Radiation Therapy of Malignant Lesions About the Eye[1]

MILFORD D. SCHULZ, M.D.,[2] and CHARLES G. STETSON, M.D.[3]

The ophthalmologic literature concerning tumors of the orbit and orbital adnexa is voluminous, and the number of patients whom the ophthalmologist sees with such tumors is considerable. The lesions of this type that are encountered by the radiologist, on the other hand, and that can be cured by him, are limited, carcinoma of the eyelid being practically the only one. Other tumors arising in or about the orbit are best treated by surgical means or are unsuitable for radiation therapy or, if suitable, can be afforded only palliation, with the possible exception of certain unusual lymphomas and retinoblastoma.

The principal tumors arising in the tissues about the eye may be arbitrarily and broadly classified as follows:

1. Orbital tumors
   - Angioma
   - Lymphoma
   - Dermoid tumors
   - Lacrimal gland tumors
   - Sarcoma
   - Granuloma
2. Extra-orbital tumors
   - Extensions from the sinuses
   - Metastatic tumors
   - Neurogenic tumors
   - Tumors of the uveal tract and retina of eye
3. Adnexal tumors
   - Conjunctival tumors
   - Tumors of eyelids

Carcinoma of the eyelid is the most common of the tumors about the eye. It accounts for approximately 60 per cent of all primary tumors arising in the tissues of the orbit and adnexa seen in the Tumor Clinic of the Massachusetts General Hospital and the Massachusetts Eye and Ear Infirmary. The major portion of this presentation, therefore, will be devoted to cancer of the eyelid; the less commonly encountered lesions will be only briefly reviewed.

## ORBITAL TUMORS

*Angiomas* are reported to account for some 15 per cent of all orbital tumors. The attitude toward radiotherapy of angiomas in this location is the same as that toward angiomas in general. Those associated with "port-wine stains" are probably not true tumors and should not be treated. The cavernous type of hemangioma and the lymphangioma are, as a rule, of mature cell type and respond poorly, if at all, to irradiation. Involution of the capillary type may be accelerated by radiotherapy given in exceedingly modest amounts but usually occurs of its own accord without treatment. There is good argument in favor of being most chary about treating any of these benign lesions with ionizing rays.

The malignant variants—hemangioblastoma, perithelioma, and endothelioma—are fortunately rarely seen even in a highly specialized radiotherapeutic department. If they are present, irradiation is indicated.

*Lymphomatous disease* of tissue in and about the orbit is the second most common tumor arising in the orbit and makes up some 10 per cent of all neoplasms about the eye. It may or may not be associated with generalized disease. It accounted for approximately 3 per cent of all lymphomas seen in the Tumor Clinic.

There is a curious type of episcleral or conjunctival infiltration occasionally seen

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by the ophthalmologist, and referred to the radiologist, which histologically is indistinguishable from malignant lymphoma. It represents about 45 per cent of all lymphomas about the eye and 1 per cent of all lymphomas seen in the Tumor Clinic (Table I). A certain number of these lesions are apparently primary conjunctival lymphomas unassociated with lymphomatous disease elsewhere. They are characterized by extremely long periods of freedom from disease following removal, whether by surgery or x-ray. Of a small group previously reported, one-half were unassociated with generalized disease, and all the patients remained well following treatment with x-rays. In the other half of the group, in which the conjunctival tumor was a part of a generalized process, the disease followed its usual relentless course. Recurrence of the lesion in the conjunctiva, however, was rare.

Lymphoma of the conjunctiva is treated with 200-kv. x-rays, with 0.25-mm. Cu filter and a short skin-target distance. The dose is 200 to 300 r daily for a total of 600 to 900 r. Rarely can the eye be protected. In 2 patients thus treated, cataract has developed. Opacity of the lens appeared five years after treatment in one, who had received 1,200 r; the second, who had received only 900 r, has recently shown signs of opacity after a latent period of five years.

The deep orbit appears to be the other area in this region in which primary lymphoma unassociated with remote disease is encountered. This usually presents as unilateral exophthalmos, and the diagnosis is established following surgical exploration. Out of a group of 16 patients with orbital lymphomas, 7 are known to have survived more than five years—not all, however, without local recurrence or manifestation of disease elsewhere. In the remainder the tumor has followed its usual less benign course.

Treatment of lymphoma of the orbit is given with 200-kv. x-rays, well filtered, through a lateral portal of entry, with the anterior portion of the eye protected. A total dose of 900 to 1,200 r, at the rate of 300 r per day, is administered. In the group studied, higher doses did not appear to accomplish any better results than lesser doses or than surgical excision alone.

TABLE I: OCULAR LYMPHOMAS (HEATH)

| Site | Number | Per Cent |
|---|---|---|
| Conjunctiva | 30 | 45 |
| Lid | 13 | 20 |
| Lacrimal gland | 2 | 3 |
| Sclera | 1 | 1 |
| Globe | 3 | 4 |
| Orbit | 14 | 21 |
| Combined | 4 | 6 |
| TOTAL | 67 | |

When lymphoma of the orbital adnexa is a part of diffuse lymphomatous disease, treatment is the same as that for lymphoma elsewhere.

*Dermoid tumors* are mature, highly organized bodies, in the management of which radiotherapy plays no part.

*Tumors of the lacrimal gland* tend to grow painlessly and silently for a long time. When finally seen by a physician, they may have invaded the bone, often extensively, and are frequently incurable. In many ways they are analogous to tumors of salivary gland origin. Early, they may be relatively benign "mixed" tumors, but after incomplete removal they often recur with increasingly malignant tendencies until they become frank adenocarcinomas. Accurate diagnosis can be made only following surgery, and in this Clinic, when total removal is possible, surgery is the treatment of choice.

The literature records these lesions as being quite radioresistant, and so the more differentiated tumors are. The undifferentiated tumor, however, the adenocarcinoma, like adenocarcinoma of salivary gland origin, is in our experience quite radiosensitive. Regression of a local recurrence and of metastatic lesions can be brought about with doses of as little as 2,000 r. No record of permanent cure, when the disease was uncontrolled by surgery, has been found, but marked palliation has often been secured.

Many competent authorities agree that

*Mikulicz's disease* does not exist as an entity, but that it represents a symptom complex due to a variety of causes—inflammatory and neoplastic—the most common of which is lymphomatous disease. Those few lesions which are classified as Mikulicz's disease have shown good regression of the tumor masses after treatment with 600 to 800 r.

*Sarcomas* arising in the tissues about the orbit are almost uniformly resistant to radiation. If cure is the aim in view, treatment of this condition is considered to lie entirely within the province of the surgeon; x-ray therapy is resorted to only for recurrence or palliation. Even palliation is rarely attainable with certainty. It is well known, however, that an occasional sarcoma elsewhere responds quite dramatically to x-ray treatment, and there is no reason to assume that the same rare success may not occur in sarcoma of the orbit, with resulting growth restraint if not cure.

*Granulomas* of the orbit, often miscalled "pseudo-tumors," are self-limited processes and call for no active therapeutic effort by the radiologist. Exceptions to this are certain metabolic disorders such as eosinophilic granuloma and Hand-Schüller-Christian's disease, both of which are quite sensitive to modest doses of x-rays, 200 to 300 r or less. It is important to recognize orbital granulomas for what they are so that active treatment may be avoided.

### EXTRA-ORBITAL TUMORS

Tumors involving the orbit secondarily from remote primary carcinomas are not uncommon. One such tumor of especial interest is the characteristic Hutchinson syndrome seen in children with *neuroblastoma*, as a local manifestation of widespread malignant disease. There are a few instances in which an abdominal primary is never discovered and in which long-term survival has followed vigorous x-ray treatment of the orbital lesion. These cases are exceedingly rare, however, and possibly spurious. It is known that maturation of a malignant neuroblastoma into a benign ganglioneuroma can occur, and this may account for a long-term "cure" of a seemingly malignant primary orbital tumor. Nevertheless, these lesions are very radiosensitive and, while cure cannot be expected, palliation with relief of pain and deformity can be obtained with small amounts of radiation, often 1,000 r or less. Unless the child is obviously an early victim of generalized disease, treatment of the orbital manifestation may afford comfort to him and to his parents.

*Carcinomas of the nasal accessory sinuses extending to the orbit* are largely problems of palliation by radiotherapy.

*Meningiomas* arising in the sphenoid wing are the principal tumors of *neurogenic origin* encountered. They, like all brain tumors, come within the province of the neurosurgeon.

*Tumors of the Uveal Tract and Retina of Eye:* Of the malignant tumors primary in the globe, *retinoblastoma* almost alone concerns the radiologist. This is a tumor of infancy and childhood, often bilateral, and is congenital, being hereditarily dominant. It is quite radiosensitive and should be radiocurable. A unilateral tumor should always be treated surgically, for in no other way can a diagnosis be established and cure be certainly assured. Reports of success by some radiologists encourage others to attempt to treat these lesions with x-rays, but our experience has been most dismal, no cures by external irradiation having been accomplished.

If, in an effort to preserve the sight of a second involved eye, it is elected to irradiate such a tumor, heavily filtered 200-kv. x-rays are employed. Opposed 2.5-cm. beams, covering the tumor, are directed toward the posterior aspect of the globe. The dose is 200 r each day, or 400 r three times a week, till a total tumor dose of 4,000 r is reached.

*Malignant melanomas*, with rare exception, are radioresistant and are strictly surgical problems.

### ADNEXAL TUMORS

Primary *carcinoma of the conjunctiva* is amenable to control by either surgery or

radiation therapy. The ophthalmologists, however, are very skillful and have accomplished most satisfactory results in the surgical removal of these lesions, which are usually small, without subjecting the eye to possible radiation damage. Some radiologists treat them with success, but in this Clinic, cancer of the conjunctiva is rarely irradiated, particularly since the eye cannot be protected. Exceptions are those lesions which are extensive or have been long neglected and in which surgical removal would require sacrifice of the eye. Results in some of these cases have been most gratifying.

The technic is essentially the same as for carcinoma of the skin, except that a short object-target distance and low-voltage x-rays are of distinct advantage. Contact therapy here would seem to be most useful. The globe cannot be protected but the lids must be.

### CARCINOMA OF THE EYELID

Carcinoma of the eyelid is essentially carcinoma of the skin but, because of its peculiar location, presents special problems in management. It is the most common of all the tumors about the eye seen by the radiologist, and the only one in which cure can be offered with any certainty.

Approximately 400 carcinomas of the eyelid have been seen in the Tumor Clinic of the Massachusetts General Hospital in a seventeen-year period, during which time probably 17,000 carcinomas of the skin have been observed. The condition is somewhat more frequent in men than in women, 60 per cent of the lesions occurring in males. As in cancer of the skin, the incidence increases with age, 75 per cent of all lesions appearing between fifty and eighty years, the peak coming in the seventh decade. If correction is made for normal population decay, the disease increases in linear fashion after forty years of age (Table II).

Basal-cell carcinomas are overwhelmingly in the preponderance, accounting for 205 of 242 biopsied lesions, or about 85 per cent; 30, or 12 per cent, were squamous-cell. The remaining 3 per cent included 4 mixed carcinomas, 2 cases of adenoides cysticum, and 1 trichoepithelioma.

TABLE II: AGE DISTRIBUTION IN CARCINOMA OF EYELID

| Age (Years) | Number | Per Cent | Per Cent Stationary Life (Relative) |
|---|---|---|---|
| 20–29 | 9 | 2 | 0.1 |
| 30–39 | 19 | 5 | 0.3 |
| 40–49 | 44 | 11 | 1.0 |
| 50–59 | 93 | 23 | 2.0 |
| 60–69 | 111 | 28 | 3.5 |
| 70–79 | 86 | 22 | 5.0 |
| 80–89 | 36 | 9 | 9.0 |
| TOTAL | 398 | | |

The most common location is the lower lid, more than 45 per cent of the entire group being so situated. The inner canthus is next most frequently involved, accounting for about 20 per cent; the upper lid, 15 per cent; the outer canthus 10 per cent; and combinations of these locations another 10 per cent.

Treatment of carcinoma of the eyelid, in order to be successful, must not only control the disease but must produce satisfactory cosmetic results with a minimal likelihood of undesirable complications. Roentgen therapy would seem to be the method which lends itself most admirably to the majority of lesions. The general principle in irradiation of these tumors is essentially the same as that employed in carcinoma of the skin in general, with certain special precautions. The eye beneath must be protected from the incident radiation. This is accomplished satisfactorily by anesthetizing the eye with 0.5 per cent tetracaine hydrochloride and inserting lead shields, either a lead meniscus placed over the globe or a long spoon-like affair, which also protects the other lid. If the lesion is extensive or of unusual contour, it is sometimes of considerable help to make a plaster cast of the part so that appropriate protecting shields can be completed at leisure and without the presence of the patient. If the primary mold is made with dental impression compound,

the final form can be quickly shaped from dental casting stone, which resists a considerable amount of handling. For treatment about the inner canthus, the old-fashioned lead nipple shield is an ideal defining device.

For purposes of treatment, carcinoma of the eyelid may be divided into four categories. *Class I* consists of small, non-infiltrative lesions which usually involve the palpebral margins. These are the tumors best suited to treatment by x-rays; a high degree of control should be obtained, with practically no resultant cosmetic defect. These cancers may be given a single dose of approximately 2,400–2,700 r. A more satisfactory cosmetic result may be obtained if the treatment is protracted over a week's time, with a total dose of 4,500 r.

*Class II* comprises tumors which infiltrate the lid and destroy tissue. These may well be treated by radiation, but a defect often occurs, especially if the white line of the lid is involved. In the older individual, this cosmetic defect may be acceptable, but in younger persons plastic repair may sometimes be required. If plastic repair will be needed to restore useful function and acceptable sightliness, it may be better to forego x-ray treatment and have immediate excision of the tumor and surgical restoration.

Lesions in *Class II*, if irradiated, should always be treated by fractionation of the dose, receiving 4,500 r in a week or, if the lesion is very extensive, its equivalent in ten days to two weeks. A short skin-target distance is always used to avoid irradiation of the deeper structures. Occasionally, rather complicated shields must be made to protect the eye and the surrounding uninvolved tissue.

*Class III* is made up of the long neglected or mistreated tumors which invade the orbit, fix the globe, or are fixed to the bony orbit. Surgical treatment of these lesions necessitates evisceration of the orbit and sacrifice of the eye. Though often it is the treatment of choice, in some instances irradiation can effect a cure and at the same time allow the retention of a usable and cosmetically satisfactory eye. It is our practice always to try x-ray treatment first in this group, and then, if the disease is not controlled by the initial attempt, resort to surgery. A rather elaborate shield must be made to protect the globe from incident radiation. Low-voltage x-rays cannot be used in treating lesions of this class. Usually 200 kv. is employed, with a short treatment distance. The dose is fractionated, 4,500 r being given in ten days for moderate-sized lesions; for extensive and deeply seated tumors, an equivalent dose is administered over a more protracted period, with well filtered radiation and an increased object-target distance.

*Class IV* tumors are almost invariably incurable. This group includes those rare lesions which have metastasized and those neglected ones which have invaded the nasal accessory sinuses or destroyed the bony orbit. If palliation is the object in view, radiation may be effective. In these cases the globe can rarely be protected. Otherwise, the general plan of treatment is practically the same as for *Class III* lesions. Curative efforts probably should be left to radical surgery.

Of our original group of 250 carcinomas which received x-ray treatment, 54 per cent were *Class I* lesions, 40 per cent *Class II*, 4 per cent *Class III*, and 2 per cent *Class IV*. Another 16 had received some form of treatment before coming to this hospital—11 surgery and 5 irradiation. A group of 154 patients have been followed for thirty months or longer.

As in all carcinoma, the stage of advancement of the disease influences the probability of control. Satisfactory control of early carcinoma of the eyelid is a matter of record, well established in the literature. It is imperative, however, that control be secured at the first treatment, for there is no better time for cure than the earliest therapeutic attempt. Failure followed by failure in the treatment of a skin cancer is bad enough, but about the eye it is doubly disastrous. The chance

of resultant deformity increases, extension to the orbit may occur, especially from lesions about the inner and outer canthi, and curative efforts will then be taken over by the surgeon. These will perforce be radical, with loss of the eye at best, and often the disease will still follow the well known course in which an uncontrolled basal-cell carcinoma, a relatively benign tumor, becomes a slow but relentless destroyer.

TABLE III: RESULTS OF X-RAY TREATMENT IN CARCINOMA OF EYELID
(Cases Followed Thirty Months or More)

| Result | Class of Primary Lesion I | II | III | IV | Total |
|---|---|---|---|---|---|
| Primary control | 61 | 64 | 2 | 1 | 128 |
| Secondary control with x-ray re-treatment | 12 | 7 | 0 | 0 | 19 |
| Secondary control with surgical re-treatment | 5 | 1 | 1 | 0 | 7 |
| Total controlled | 78 | 72 | 3 | 1 | 154 |
| Complete failures* | 2 | 4 | 6 | 2 | 14 |
| | 80 | 76 | 9 | 3 | 168 |

* Includes 3 patients who had been treated before admission to the Massachusetts General Hospital but not 6, followed less than thirty months, considered initial failures.

In the *Class I and II* lesions of the present series, primary cures with freedom from disease for two and a half years were effected in 125 cases, or 80 per cent of the 156 cases falling into these categories (Table III). Of the patients first seen with far advanced disease, *Classes III and IV*, control was achieved by the initial treatment in 3.

If control of the disease is not to be obtained by irradiation, failure is usually manifest early—during the first year as a rule; rarely does the tumor recur after the third year. In only 2 of the initial failures of roentgen therapy in this series was recurrence preceded by a period of freedom from disease of more than two years (Table IV).

It seems much more important to examine the reasons for initial failure in the smaller group than the reasons for success in the larger group. In 19 initial failures in treatment of *Class I and II* lesions, control of the disease was obtained with subsequent irradiation, indicating that the fault lay in the manner of treatment and not in the extent or nature of the tumor. This raised the total ultimate success of x-ray therapy in early cancer of the eyelid to above 90 per cent. Secondary surgical attack after primary x-ray failure was successful in 7 cases. In another 6, failure was complete in lesions which should have been curable (Table III).

TABLE IV: INTERVAL BEFORE RECURRENCE IN 46 INITIAL X-RAY FAILURES

| Time Interval | Number Failures |
|---|---|
| None | 6 |
| 1–5 months | 30 |
| 6 months–1 year | 6 |
| 1–2 years | 2 |
| 2–3 years | 2 |
| Over 3 years | 0 |
| TOTAL | 46 |

In 1 of the last group, metastases occurred from a squamous-cell carcinoma located on the upper outer eyelid. Five of the 6 failures were due to persistent and uncontrolled disease. All 5 lesions were basal-cell carcinoma and, with a single exception, were situated at the inner or outer canthus. In all there had been many ineffective attempts at control, and all probably fell into that class of skin tumors, usually basal-cell, in which initial failure, in many instances because of inadequate treatment, is followed by the too well known long train of unhappy events in which radiation therapy and surgery take turns in failure.

Of the uncontrolled, advanced lesions in the group termed "complete failures," all but one had originated at the inner or outer canthus; one-half were basal-cell carcinomas.

The marked difference in the occurrence of primary failure in relation to the *histology of the tumor* is interesting. The likelihood of failure in squamous-cell carcinoma is far greater than in basal-cell. Nine, or 30 per cent, of the biopsied squamous-cell carcinomas, as contrasted to 17, or 8 per cent, of the biopsied basal-cell lesions, fell into the initial failure group.

The *location of the tumor* as a cause of failure seems to be insignificant, except that lesions about the canthi tend to invade the orbit and sinuses more promptly. Those in the outer canthus are somewhat more prone to failure than those elsewhere about the eye. In this small group, failures in lesions of the outer canthus were relatively twice as frequent as the incidence of the disease in this location.

By and large, the most common cause of failure appears to be a technical one—either inadequate dose or inadequate treatment fields.

*Complications:* In early carcinoma of the eyelid treated with x-rays, complications attributable to the radiation should be almost entirely avoided. Late *radiation necrosis* may be expected if the skin and normal tissues are unnecessarily damaged by the use of excessively large doses of radiation or if smaller doses are ineffectually repeated over extensive areas. Trauma, infection, and persistent moisture because of epiphora are also contributory causes. In the present series, radiation necrosis occurred in 4 cases (1.7 per cent) treated in the early stages of the disease, and 2 cases (1.3 per cent) of advanced disease. Repetition of the treatment was accounted as responsible for the necrosis in 2 of the early lesions, too large an area of treatment in 1. In 3 cases, the dose was not repeated and was not excessive according to the time-dose relationship defined by Strandqvist, and the necrosis probably was attributable to trauma, possibly from pressure of eye-glasses on scar tissue.

Irradiated skin is less able to tolerate trauma than normal skin, and the pressure of glasses upon a treated area is often the exciting cause of tissue breakdown. In any person who has had x-ray treatment about the inner canthus, care should be taken to see that the weight of eyeglasses is not borne by scar tissue.

Careful attention to the details of treatment, making sure that the first treatment is the right one or recognizing a radioresistant lesion and employing surgery rather than radiation therapy, should prevent radionecrosis in lesions of Class I and II. In advanced tumors, the risk of breakdown may have to be accepted as the price of cure.

*Stenosis of the tear duct* occurs not infrequently when the ducts must be included in the field of radiation. This often happens when the tumor has already involved and destroyed the papillae. Careful probing of the tear ducts by an ophthalmologist can sometimes restore patency or prevent closure of the ducts, but this is not always a successful maneuver. Stenosis occurred in 11 cases in this group.

*"Tearing"* is relatively common and sometimes may be an annoying aftermath of radiation therapy. More often than not it is attributable to deformity caused by the disease rather than to the treatment *per se*. If the tumor infiltrates and destroys the lid, the resultant deformity is usually sufficient to interfere with the normal control of tears, and if the lacrimal duct system is interfered with, some epiphora will be inevitable. In 6 patients this was a persistent complication after irradiation.

Severe *deformity of the lids* does not occur as a complication of ordinary x-ray treatment. When, however, tissue has been destroyed by tumor, some deformity is bound to occur and must be accepted. In many cases the residual deformity is considerably less than would be expected from the extent of the disease. If it is evident that deformity will be excessive if the disease is to be controlled, and this is unacceptable to the patient, immediate surgical removal of the tumor and plastic repair should be substituted for irradiation.

Some degree of thinning of the lid with loss of eyelashes may follow treatment that extends to the lid margin. This, however, can seldom be called a significant deformity. But if the so-called white line of a lid margin is cut when a biopsy is taken or is destroyed by tumor, a small notch almost invariably remains visible.

*Conjunctivitis* or *keratitis* may result from irradiation. These conditions may be due to mechanical factors or to the effect of

radiation on the tissues. Bulbar conjunctivitis can be avoided by careful shielding and attention to details of treatment, except when the disease is extensive and involves the globe. In such cases, conjunctivitis must be accepted as an annoying but necessary result of treatment. This complication occurred in 10 patients after irradiation; in 2, it was a transient complaint, while in the remainder it was persistent, and in a few, severe.

*Cataract* is a complication of treatment which should occur only when the disease is so extensive that the globe cannot be shielded from irradiation. It has been estimated that the adult human lens can tolerate 800 r without production of cataract; proper shielding will avoid such a dose to the lens. A long latent period, as long as five years or more, may intervene between treatment and the appearance of opacity of a lens. Even when the globe cannot be protected and a cataract is anticipated, useful vision is sometimes retained for a long time. Only 1 cataract attributable to irradiation treatment of cancer of the eyelid has been seen in this series; it was in a patient with advanced disease.

*Loss of the eye* due to radiation occurs only in advanced disease. When protection of the globe cannot be accomplished, this risk must be taken. In such instances it is better to advise pre-irradiation enucleation. These situations are usually, but not invariably, encountered in disease which is incurable.

*Metastasis* can hardly be classed as a complication of treatment but rather as a complicating factor in the course of the disease. It has occurred in 10 per cent of patients whose biopsied tumors were histologically deemed capable of metastasizing; this is probably a statistically invalid figure. The metastases in each of the 3 patients involved the pre-auricular lymph nodes; in 1, the nodes of the neck were also involved. Two patients are known to have succumbed to their disease. Two of the lesions were on the upper eyelid, involving the outer canthus, and the other originated in the inner canthus.

## SUMMARY AND CONCLUSIONS

Of the large number of tumors about the eye seen by the ophthalmologist, the ones most hopefully encountered by the radiologist are carcinoma of the eyelid and lymphoma of the orbital adnexa.

In its early stages, carcinoma of the eyelid should have a high rate of cure with radiation therapy but, as is the case in carcinoma of the skin, a few lesions resist all attempts at cure. Advanced and neglected cancer of the eyelid presents an unfortunate situation as far as cure is concerned. Untoward complications following irradiation should be avoidable by careful selection of material and painstaking treatment.

A few lymphomas of the conjunctiva may be spoken of as "curable." The majority, while responsive to radiation therapy, are usually but another manifestation of a generalized lymphoma.

Metastatic neuroblastoma of the orbit and primary carcinoma of the lacrimal glands show good palliative response to radiotherapy. Curative attempts have been discouraging.

Hope and optimism in the face of discouraging results attend the treatment of retinoblastoma by external radiation.

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## SUMARIO

### Radioterapia de las Lesiones Perioculares Malignas

Del gran número de tumores situados alrededor de los ojos, los de mayor interés, desde el punto de vista de la roentgenoterapia, son el carcinoma de los párpados y el linfoma de los anexos de la órbita.

El carcinoma palpebral es el único en el que quepa esperar la curación con alguna certidumbre. Las pequeñas lesiones no in-

filtrantes (Clase 1), que suelen afectar los bordes de los párpados, son las que se prestan major para la roentgenoterapia y deben rendir un elevado coeficiente de curaciones. También puede irradiarse a los tumores que infiltran el párpado y destruyen tejido (Clase 2), fraccionando la dosis, pero tal vez sea inaceptable, sobre todo en los jóvenes, el resultado estético, en cuyo caso la excisión quirúrgica es el tratamiento de elección. Los tumores descuidados por mucho tiempo o mal tratados que han invadido la órbito (Clase 3) crean una situación lamentable en lo tocante a curación. Los AA. ensayan primero la roentgenoterapia en esos casos, pues puede a veces lograr la curación. Si no queda dominada la enfermedad con el tratamiento inicial, está indicada la cirugía. Por último, los tumores raros que han formado metástasis y los descuidados que han invadido los senos paranasales o destruído la órbita ósea (Clase 4) son casi invariablemente incurables, aunque la irradiación puede obtener un resultado paliativo favorable.

Puede designarse como "curables" a unos pocos linfomas de la conjuntiva, pero la mayoría, aunque responden a la irradiación, no suelen constituir más que una manifestación de una dolencia generalizada que prosigue inexorablemente su evolución habitual.

El neuroblastoma metastático de la órbita y el carcinoma primario de las glándulas lagrimales muestran buena respuesta paliative a la radioterapia, per los esfuerzos curativos han sido desalentadores.

El retinoblastoma es radiosensible, pero son desanimadores los resultados de la radioterapia en esos tumores.

La radioterapia puede ir seguida de complicaciones graves en las lesiones perioculares. Hay que evitar éstas por medio de la cuidadosa selección de los casos y prestando meticulosa atención a los detalles del tratamiento.

## DISCUSSION

**Donald J. Lyle, M.D.** (Cincinnati, Ohio): Obviously the best treatment for malignant tumors about the eye is that which eradicates the disease and at the same time retains visual function and results in minimum disfigurement. As with most everything of vital interest and importance, there is frequently difference of opinion regarding the best procedure. Opposing views concerning the proper treatment are not shared by ophthalmologists on the one hand and radiologists on the other, but members of both specialties may have the same opinion. The reason for these diverse opinions is based upon personal experience and is formulated from statistical appraisal of the type, location, and extent of the various lesions. One group stresses the eradication of the malignant growth by surgical measures, with the possible exception of carcinoma of the lids. The opinion of another group is that tumors about the eye, whether epiblastic or mesoblastic, should not be removed by surgery, possibly with the exception of retinoblastoma. They believe that after proof is established by biopsy, the tumor should be submitted to irradiation without further surgical intervention. It is the general opinion, I believe, that biopsy—either by excision or by aspiration—is necessary for precise anatomic and pathologic diagnosis. However, one must consider the danger of exciting greater activity by such procedure and be prepared to remove the entire tumor forthwith if its nature so indicates.

Only after the type, location, and extent of the tumor have been determined should the procedure for its eradication be decided upon. This decision should usually be effected by consultation between the ophthalmologist and radiologist, as adequate knowledge of both specialties is seldom acquired by the same individual. The protection of the function of the eye should be the concern of the ophthalmologist; the administration of irradiation that of the radiologist.

The first requisite is to determine if the tumor in question is radioresistant or radiosensitive. If it is radioresistant, surgery should be resorted to. If it is radiosensitive, one must then decide which procedure, surgery or irradiation, will eradicate the tumor with the least impairment to ocular function and the least disfigurement and complicating annoyance. It may be necessary, especially in extensive and advanced cases, to resort to both surgery and irradiation. In these cases experience is the greatest teacher and one should, through his own investigation and reports of others, weigh the advantages against the disadvantages in both procedures.

As a general rule, irradiation is usually pre-

ferred to surgery, as it is less annoying, requires less hospitalization and loss of time, and is usually more economical. However, one must consider the complications. They are influenced by the location and extent of the lesion and the amount of irradiation required. One must remember that it is more serious to re-irradiate than to re-operate, as necrosis of the tissues by over-irradiating previously treated fields is quite possible. For this reason, one may prefer surgical removal of the tumor followed immediately by plastic repair.

As the complications have been mentioned, I do not want to repeat them. I should like to mention, however, that the lacrimal gland may be destroyed by irradiation, resulting in a dry and irritated eye. I also would like to state that once or twice I have seen the production of secondary glaucoma due to some damage of the drainage angle of the eye. The patient should be informed beforehand of the possibility of complications, and, depending upon the area involved, the symptoms he may expect and have to tolerate. These complications can be reduced to a minimum if the proper attention is devoted to protective measures. Post-irradiation erythema is to be expected. Irritation is kept to a minimum by the use of a bland ointment or jelly.

For lid lesions, a cast of the area is made with dental plaster, covering, in addition to the lids of both eyes, the nose and adjacent forehead, temple, and cheek. This cast is then covered with a lead sheet of about 1/32 inch in thickness and molded to contour. The center of the area to be treated is outlined on the lead mask, punched out, and enlarged to conform with the size of the lesion.

For treatment of a tumor of the anterior segment of the globe or of the deeper structures, a local anesthetic is instilled and Moldite powder or Coe-loid powder is made into a paste and used according to the molding procedure in making casts for contact lenses. This cast of the anterior segment of the globe is then covered with a lead sheet and molded to contour. The area over the tumor is spotted on the mold, punched out, and shaped to the lesion. It is well to keep some of the lead plate above and below to act as a lid retractor or speculum to help separate the lids and expose the area for treatment. The lead mold is then dipped into melted paraffin for a thin coating to reduce irritation to the eye. When the lead mold is not in use, the plaster cast should be placed in it to retain the shape. This mold may be used also for protection of the globe and orbit in irradiation of the lids.

A cone applicator may be used in place of these lead masks for treatment of certain cases where danger of damage to the eye or its supporting structures is not likely or of no consequence.

The essayists state that in their opinion those malignant tumors about the eye yielding to irradiation are the carcinomas of the lids, especially basal-cell, and lymphomatous tumors of the lids, conjunctiva, and orbit. I quite agree with their selection of cases and with their treatment. There is no doubt that epithelioma of the lid can be arrested, if the lesion is not too extensive, with very little impairment of ocular function or cosmetic disfigurement if the eye is properly protected during irradiation. If the tumor is bulky and ragged, it might be well to excise down to the base and then irradiate. For advanced invasive tumors when loss of the eye is inevitable, I believe irradiation is also advisable, possibly after enucleation.

In carcinoma of the conjunctiva, I consider surgery the procedure of choice. It might be well to follow it by irradiation. If the cornea is involved, surgery should be resorted to. Frequently, the corneal invasion limits itself to the surface and does not penetrate deep into the stroma, so that surgical removal with little damage may be effected. When irradiating these areas, one must be careful not to produce necrosis of the sclera or secondary glaucoma.

All lymphomatous tumors are radiosensitive and are successfully treated locally by irradiation. It must be remembered that there may be a general disease and the tumor within the orbit may not be solitary or primary. Surgery need be resorted to only for diagnostic biopsy.

Hodgkin's disease yields very well to irradiation, especially in local form. Mikulicz's disease yields well to irradiation when caused by lymphomatous disease, less well if produced by tuberculosis, sarcoid, and other granulomatous processes. Mixed tumors of the lacrimal gland have not, from my observation, been affected by irradiation.

As stated above, radiosensitive tumors should be treated by irradiation unless surgery is quite simple. Those less sensitive may, at times, be irradiated. The resistant tumors are best treated by surgery.

**Brig. Gen. E. DeCoursey** (Washington, D. C.): In Japan, as you know, radiation cataracts developed in quite a few atomic-bombed persons at less than lethal dosage, apparently therefore at less than around 800 r. A neutron component of the radiation may have been relatively more injurious. Kimura and Cogan have described regression in some of these radiation cataracts. Christenberry, Upton and Furth in Oak Ridge have shown that over 50 per cent of mice, at a single dose of less than 50 r, get opacities that can be seen by slit-lamp biomicroscopy. I would like to make a plea that the radiologists and ophthalmologists get together and that, in those cases where the eye cannot be fully protected, there be slit-lamp biomicroscopic examination for opacities. Some may form and disappear without subjective symptoms. Both negative and positive findings would add to our knowledge.

# Roentgenologic Study of Meckel's Diverticulum[1]

## Case Report

ALEXANDER LEWITAN, M.D.

THE PREOPERATIVE diagnosis of Meckel's diverticulum is unusual. Pfahler described two cases diagnosed roentgenologically in 1934, and since that time cases have been recorded by Ehrenpreis (1939), Skinner and Walters (1939), Rousseau and Martin, who collected 12 cases beside their own (1943), Hallendorf and Lovelace (1947), Grossman, Fishback, and Lovelace (1950), Elias and Ladin (1950), and Raffensperger and Markunas (1950). The following case is of interest not only because the diagnosis was made prior to operation but because of the detailed fluoroscopic observations, a feature which has been neglected by most writers.

### CASE REPORT

B. S., a woman of 35, had come to the United States in February 1949. Her husband and child had been killed during the war, and she had spent four years in a concentration camp. Her father and mother had died before she reached the age of ten. One sister was living, in a mental institution.

As a child, the patient had measles, scarlet fever, and chickenpox. She was hospitalized for a few days in 1935 because of an abscess under the left arm, and in 1936 she had a so-called gallbladder attack, treated at home. For the past three years she had experienced gastric distress coming on one or two hours after meals and not relieved by alkalis. She complained also of a sense of fullness in the lower abdomen and of cramp-like pains occurring sometimes in the right upper quadrant, at times in the right lower quadrant, and again crossing the midline.

Laboratory investigations, including a blood count, urinalysis, a Wassermann test, and blood chemistry determinations, were reported as normal. The physical examination was non-contributory. The blood pressure was 108/70. A chest film showed fibrotic lesions in both pulmonary apices, which remained unchanged over a period of three years. A gallbladder examination carried out on March 30, 1951, because of right quadrant pain, showed nothing of significance. Some relief was afforded by dietary measures and antispasmodics.

Because of recurrence of pain, a gastrointestinal study was undertaken Nov. 1, 1951. On the four- and six-hour films (Fig. 1) a collection of air was demonstrable within a diverticulum arising from the distal ileum and located within the right upper quadrant. Its location and its relation to the distal ileum were suggestive of a Meckel's diverticulum. The remainder of the digestive tract was normal.

Re-examination was done on Nov. 5. Repeated fluoroscopic observations of the small bowel were carried out and finally the diverticulum was again visualized, not in its earlier location but in the pelvis, crossing the mid-line toward the left. It no longer appeared as an air-containing sac but was filled with barium (Fig. 2). Peristalsis altered the outline (Fig. 3) changing the configuration and affecting the base but not the neck. The peristaltic action did not completely empty the diverticular contents during the period of fluoroscopic observation. Because of these findings, a diagnosis of Meckel's diverticulum was advanced. A barium enema study was done on Nov. 9 and the terminal ileum was filled in an attempt again to visualize the diverticulum. It was only poorly shown, however, because of distended ileal coils which partially obscured it. It was impossible to be sure of its filling at the time of roentgenoscopy.

On Feb. 11, 1952, diverticulectomy and appendectomy were performed by Dr. David Kershner. The diverticulum was found to be 25 cm. from the cecal junction on the antimesenteric side (Figs. 4 and 5). It was excised transversely and was found to measure 2.5 cm. in diameter at the base and 2 cm. in length. It appeared conical in shape. It was lined by a wrinkled, glistening mucosa with some areas of gray discoloration. Histologic examination showed small bowel mucosa, the presence of muscular layers within the wall, and inflammatory changes. *Diagnosis:* Meckel's diverticulum.

The patient did well following surgery. To date, eight months after operation, there has been no recurrence of symptoms.

### DISCUSSION

Meckel's diverticulum is a persistent remnant of the omphalomesenteric duct. It is found more frequently in males than in females, in a ratio of 3:1. In 5,768 autopsies Christie found a Meckel's diver-

[1] From the Radiological Section of the Jewish Sanitarium and Hospital for Chronic Diseases (Director Dr. L. Nathanson), Brooklyn, N. Y. Accepted for publication in November 1952.

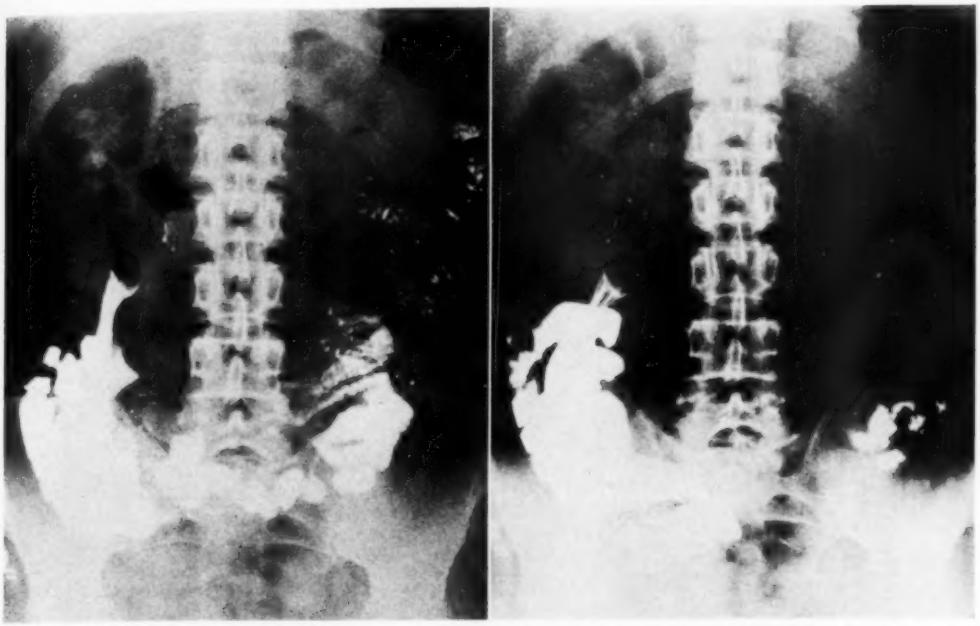

Fig. 1. On the four-hour film (left) of the first examination a collection of air was seen in the diverticulum arising in the terminal ileum. The loop was seen extending upward in the right upper quadrant. The same finding was encountered on the six-hour film (right).

ticulum present in 1.1 per cent. Because of the possibility of complications arising in the diverticulum it is considered surgically important; it is these which frequently lead to its discovery on exploration. Among them are inflammation, ulceration, perforation, hemorrhage, intussusception, intestinal obstruction, and the presence of tumor. Nygaard and Walters collected twenty cases of malignant tumors in Meckel's diverticulum. In large surgical series Meckel's diverticulum is found in approximately 2 per cent of the cases. Because of the inflammation usually associated with the diverticulum and consequent closure of the duct, barium rarely enters the sac and hence it is rarely diagnosed preoperatively.

A review of the clinical history in the case reported above and its correlation with the x-ray findings serves to explain the bizarre subjective complaints on the basis of the anatomical position of the diverticulum. The patient at one time had pain in the right upper quadrant, simulating a

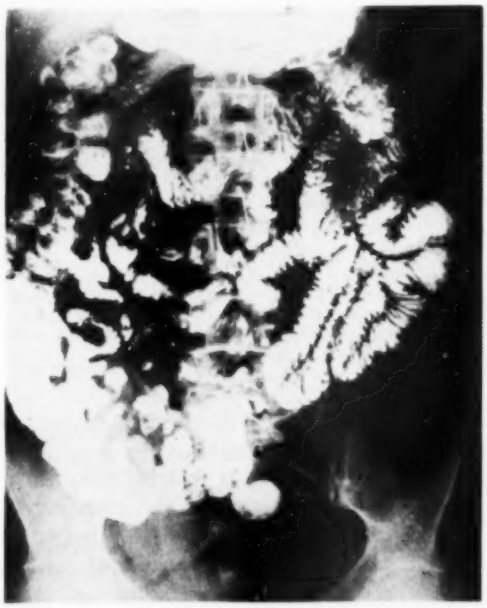

Fig. 2. On re-examination the diverticulum was filled with barium. Its location had changed, and it was now seen overlying the sacrum. It was demonstrated only on the seven-hour film.

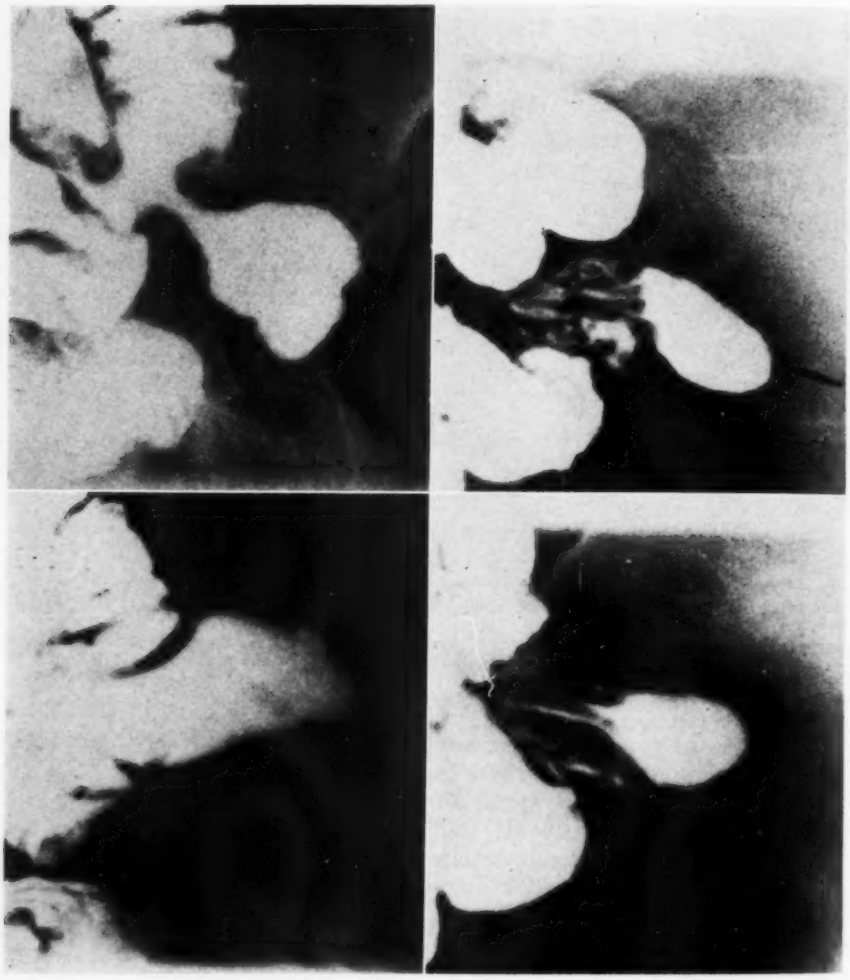

Fig. 3. The diverticulum was identified during fluoroscopy, and spot films were obtained showing peristaltic action of the diverticular wall, changing its appearance and configuration. This represents a basic difference from other roentgenologically demonstrable diverticula, as it indicates the presence of a muscular wall, making the diagnosis of Meckel's diverticulum possible.

gallbladder attack; at other times pain was localized in the left lower quadrant and right lower quadrant. On the serial studies of the small bowel the diverticulum was shown to be occasionally situated below the liver and at other times in the pelvis. This may account for the variation in the referral of pain.

Pfahler, who first described the roentgen features of Meckel's diverticulum, reported two cases. In the first case operative confirmation was available but fluoroscopy was impossible because of a history of bleeding and because the child struggled too much during the examination. In his description, Pfahler stresses the change in configuration of the diverticulum, due to active peristalsis, and its relatively fixed position. He also mentions the difficulty of refilling the diverticulum on a second examination even though it may have been demonstrated previously.

Meckel's diverticulum is a true diverticulum, *i.e.*, all layers of the intestine are

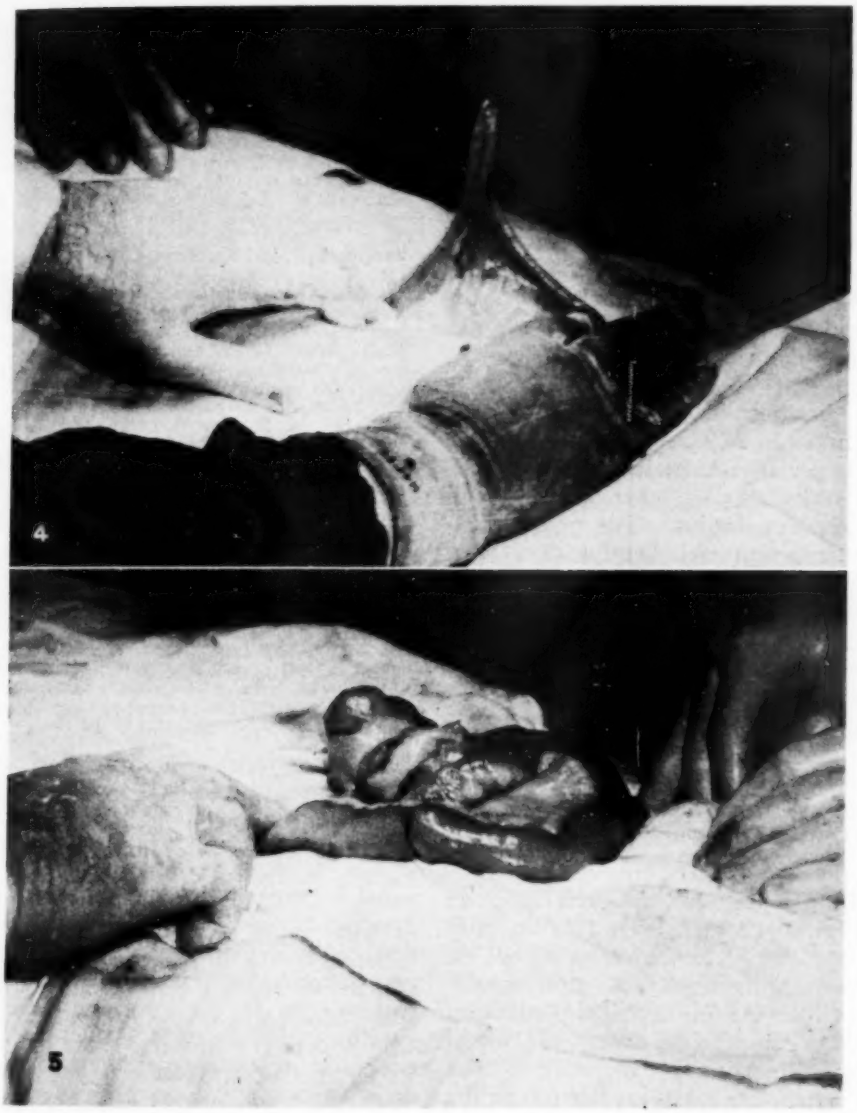


Fig. 4. The appearance of the terminal ileum with the diverticulum arising on the antimesenteric side, before resection, at the time of operation.

Fig. 5. The anatomical relationship of the diverticulum to the cecum as seen after operation. The Meckel's diverticulum was 25 cm. from the cecum.

present. Acquired diverticula are composed of mucous membrane supported by either little or no smooth muscle. Peristaltic action indicates the presence of a muscular wall, which is not present in other diverticula of the intestine usually encountered on roentgen examination. It is this peristaltic action, altering the outline of the diverticular wall, which makes the diagnosis of Meckel's diverticulum possible. The relatively fixed position observed by Pfahler was not found in our case. On the second examination the diverticulum occupied an entirely different location than

that originally observed. Elias and Ladin also describe the presence of air within the diverticular sac, which makes its recognition feasible.

With greater attention to small bowel studies, which are now more commonly used, this condition will be more readily diagnosed. It will, however, remain a time-consuming procedure, since an anomaly suggested on routine examination must be carefully evaluated by spot films and serial studies.

SUMMARY

The roentgen features of a Meckel's diverticulum in a 35-year-old female are described. Definite peristaltic action deforms the diverticular wall, changing its configuration and outline. The presence of peristaltic action is indicative of a true diverticulum and differentiates it from other roentgenologically demonstrable diverticula. The position of the diverticulum changed on various examinations.

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SUMARIO

**Estudio Roentgenológico del Divertículo de Meckel: Historia Clinica**

Preséntase un caso de divertículo de Meckel en una mujer de 35 años de edad, prestando en particular atención a los hallazgos roentgenográficos y fluoroscópicos. Observóse que la acción peristáltica alteraba el contorno del divertículo, modificando la configuración del mismo. Esa acción peristáltica indica la presencia de una pared muscular y sirve para diferenciar un divertículo de Meckel de los divertículos adquiridos del intestino, que contienen poco músculo liso o no contienen ninguno. Notóse que la posición del divertículo variaba en los distintos exámenes, lo cual explicaría los peculiares síntomas subjetivos de la enferma.

# Some Factors Influencing the Roentgen Visualization of the Mucosal Pattern of the Gastrointestinal Tract[1]

HAROLD E. SHUFFLEBARGER, M.D., PETER K. KNOEFEL, M.D., JANE TELFORD, M.D., LAWRENCE A. DAVIS, M.D., and EVERETT L. PIRKEY, M.D.

## HISTORICAL REVIEW (1, 2*a*)

WITHIN THE YEARS immediately following the discovery of x-rays, the possibility of visualizing the stomach and intestines by the use of radiopaque media had been realized and explored. Since the introduction of barium sulfate, it has remained the single important intestinal contrast material.

The earliest observations concerned the movements and motility of the gastrointestinal tract, mostly in animals, with little attention to morphological detail. In man, because of inability to obtain satisfactory radiographs, the study of disease became one of "symptom-complexes," wherein the mobility, shape, and peristaltic activity of the stomach and intestines, observed fluoroscopically, determined the diagnosis. Toward the end of the first decade of the present century, with improvement in design of transformers and the introduction of fluorescent screens, the radiopaque filled viscus could be filmed, with demonstration of its outline and of the larger defects.

Shortly after this, the importance of visualizing the mucosal folds was realized, and the sedimentation method was introduced. Following ingestion of a thin bismuth solution, the patient remained in a supine or prone position for twenty minutes, after which a film was exposed. Soon afterward it was found that, with the use of a small amount of medium carefully distributed over the gastric wall by positioning, the entire mucosal pattern could be outlined.

In 1921, Åkerlund (3) introduced his thin-layer compression technic for the demonstration of duodenal cap lesions. Pressure correctly applied displaced all excess medium and left only the mucosal outline and any associated defects. This method was adapted for the visualization of the mucous membrane of the stomach during fluoroscopy.

Repeated attempts have been made to improve the quality of the pattern by using different media or adjuvants to the standard media. Among these are buttermilk, tragacanth, acacia, honey, and more recently mucin (4), oil (5), gelatine (6), saline (7), and colloidal aluminum hydroxide (8).

During the past decade, attention has been directed to the particle size of the medium itself, and several investigators (2*b*, 8–11) have claimed to have obtained improved mucosal studies with the use of barium sulfate of small particle size.

To our knowledge, there have been no detailed investigations relating the state of individual resting gastric function, such as *p*H, mucin production, and motility, to the mucosal pattern as obtained on films or at fluoroscopy, nor has there been any correlation between the type of stomach (asthenic, hypersthenic, etc.) and the excellence of mucosal detail obtained.

## EXPERIMENTAL PROCEDURES AND RESULTS

The materials used in the present studies were as follows:[2]

1. Barium sulfate, U.S.P.

[1] From the Departments of Pharmacology and Radiology, University of Louisville School of Medicine, Louisville, Ky. Aided in part by a grant from the Research Laboratories, Eastman Kodak Company, Rochester, N. Y., and by a grant from the Kentucky State Research Commission. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

[2] Barium sulfate micropowder furnished through the courtesy of Dr. Melvin Thorpe, Research Laboratories, Mallinckrodt Chemical Works, St. Louis, Mo. Barium sulfate, 1.05, 0.5, and 0.35 $\mu$, furnished in experimental quantities by the Research Laboratories of the Eastman Kodak Co. "I-X barium (Industrial X-ray Research Laboratories) containing over 90 per cent $BaSO_4$, U.S.P., and an insoluble, inert suspension agent.

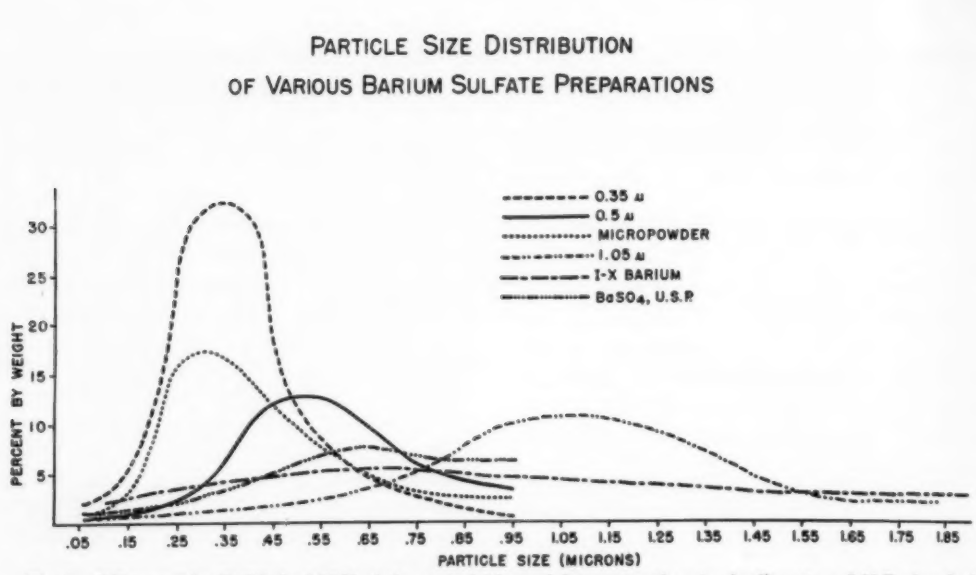


Fig. 1. Micropowder $BaSO_4$ had 30% of the material by weight greater than 1 $\mu$ in diameter; I-X Barium had 81% greater than 1 $\mu$ and 63% greater than 2 $\mu$; $BaSO_4$, U.S.P., had 56% greater than 1 $\mu$.

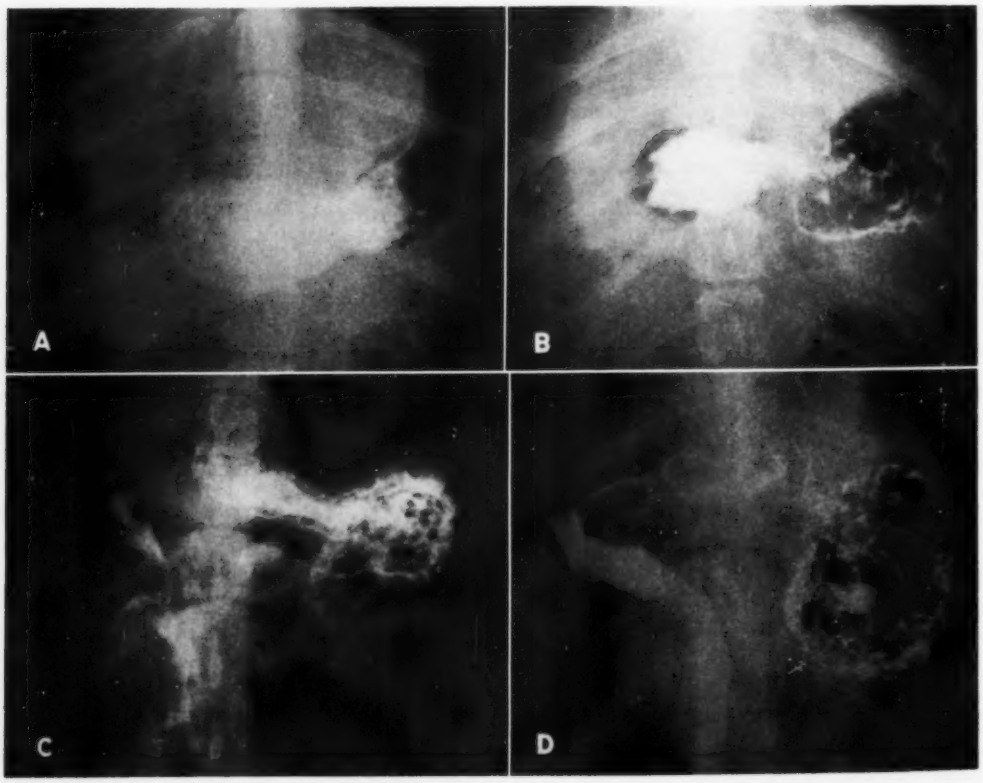


Fig. 2. Roentgenograms of dog stomachs following the injection of air and $BaSO_4$ as described in the text. A represents 1 plus; B, 2 plus; C, 3 plus; D, 4 plus.

TABLE I. RESULTS OF ANIMAL EXPERIMENTS UNDER BASAL CONDITIONS

| | Spot | | | | | Chin | | | | | | Crip | | | | | | Avg. per Material |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | Avg. | 1 | 2 | 3 | 4 | 5 | Avg. | 1 | 2 | 3 | 4 | Avg. | | |
| Barium sulfate, U.S.P. | +++ + | +++ | +++ | ++ | 2.8 | ++++ | ++++ | +++ | .. | .. | 3.7 | ++++ | .. | .. | .. | 4.0 | | 3.4 |
| Micropowder barium | ++ | +++ | +++ | .. | 2.7 | +++ | ++ | ++++ | .. | .. | 3.0 | + | .. | .. | .. | 1.0 | | 2.2 |
| Barium sulfate, 1.05 $\mu$ | + | ++ | ++ | ++ | 1.8 | + | +++ | +++ | +++ | +++ | 2.6 | ++ | ++ | ++++ | ++ | 2.5 | | 2.3 |
| Barium sulfate, 0.5 $\mu$ | ++ | +++ | +++ + | .. | 3.0 | ++++ | ++++ | ++++ | .. | .. | 4.0 | +++ | ++ | ++ | .. | 2.3 | | 3.1 |
| Barium sulfate, 0.35 $\mu$ | + | +++ | +++ | +++ | 2.5 | +++ | +++ | +++ | .. | .. | 3.0 | ++ | .. | .. | .. | 2.0 | | 2.5 |
| Average per dog | | | | | 2.5 | | | | | | 3.3 | | | | | 2.4 | | |

2. Barium sulfate micropowder, Mallinckrodt
3. Barium sulfate, 1.05 $\mu$
4. Barium sulfate, 0.5 $\mu$
5. Barium sulfate, 0.35 $\mu$
6. Barium sulfate (I-X Barium)

A mixture of two parts of water and one of the compound under investigation was employed.

The distributions of particle size were determined[3] by the method described by Jacobsen and Sullivan (12), and are given in Figure 1.

### *Animal Experiments*

(H. E. S., P. K. K., and J. T.)

(*1*) *Basal Conditions:* The procedure used in three trained 15-kg. bitches (Spot, Chin, and Crip) was as follows:

(*a*) Regular diet the morning of the preceding day with evaporated milk given that evening.

(*b*) The following morning a No. 14 F Levin tube was passed into the stomach for a distance of 79 cm. from the incisor teeth and 30 ml. of air was injected. The tube was withdrawn for a distance of 33 cm. and into it were introduced 17 ml. of the barium sulfate suspension, so that 10 ml. actually entered the stomach. The tube was then removed.

(*c*) The dog was rolled and tilted thoroughly in an attempt to distribute the suspension evenly.

(*d*) Roentgenograms were made in the prone position at intervals of one, five, fifteen, and thirty minutes.

The roentgenograms were evaluated (L.A.D. and E.L.P.) upon the basis of the percentage adherence of the material to the gastric wall and the clarity of the overall mucosal pattern. Using these standards, the films were divided into four groups, as shown in Figure 2. The results are tabulated in Table I.

(2) *Experiments with Histamine, Atropine and Insulin.* The above procedure was repeated with the following additions.

[3] By the Research Laboratories of the Eastman Kodak Co.

TABLE II. RESULTS OF ANIMAL EXPERIMENTS WITH HISTAMINE AND INSULIN

| Function* | Spot | | | Chin | | | Crip | | |
|---|---|---|---|---|---|---|---|---|---|
| | Control | Histamine | Insulin | Control | Histamine | Insulin | Control | Histamine | Insulin |
| Rate | 1.2 | 5.1 | 1.1 | 2.0 | 6.0 | 1.8 | 1.7 | ... | 1.1 |
| $H^+$ ion | 46 | 87 | 126 | 34 | 79 | 21 | 52 | 65 | 26 |
| Acid | 76 | 132 | 126 | 91 | 136 | 118 | 94 | 102 | 117 |
| Mucin | 142 | 30 | 60 | 83 | 45 | 190 | 100 | 64 | 132 |
| Blood sugar | 100 | ... | 60 | 79 | ... | 32 | 64 | ... | 28 |
| X-ray | 2.8 | 2 | 2 | 3.7 | 1 | † | 4 | 3 | 3 |

* Rate, ml./min.; $H^+$ ion, mEq/L; acid, titratable acidity mEq/L; mucin, mg./100 ml.; blood sugar, mg./100 ml.; x-ray, expressed as a score as calculated above.
† Films unsatisfactory.

(*a*) Meat extract was added to the evaporated milk for the evening meal.

(*b*) The method (13) of Coy[4] was used to obtain gastric secretion and to record gastric motility during a control period of approximately thirty minutes, following which 0.2 mg. of histamine, 1.0 mg. of atropine, was injected subcutaneously or 10 units of insulin were given intravenously. Observations of the secretory activity and motility of the stomach were continued for thirty minutes. The Coy apparatus was then removed. Air and the barium sulfate U.S.P. suspension were injected and films made as outlined above.

The volume and *p*H (glass electrode) of the gastric secretion were measured. The secretion was titrated with sodium hydroxide to phenolphthalein, and the mucin content determined as dextrose after two hours hydrolysis in $2N$ $H_2SO_4$ in a boiling water bath. Venous blood sugar levels were obtained both before and after the injection of insulin.

The films obtained were sorted as noted above. The results of this study are recorded in Table II. The data for histamine and insulin are those of the final period of aspiration, immediately preceding the introduction of barium sulfate. No values for atropine are tabulated, as no secretion was obtained following its injection.

### *Human Experiments*

Nine subjects were given 1 oz. each of "I-X barium," 1.05 $\mu$ and 0.5 $\mu$ barium suspensions on successive days, and films were obtained. These were evaluated by the same method as noted above by several experienced observers. There was no appreciable difference in the mucosal pattern obtained with the various suspensions in the same subject. Furthermore, the best consistent patterns were obtained in those with hyposthenic type stomachs. See Figure 3.

[4] We are indebted to Dr. F. E. Coy, Jr., Army Medical Research Laboratory, Fort Knox, Ky., for supplying us with his apparatus.

## DISCUSSION

The animal experiments conducted under basal conditions indicate that the 0.5 $\mu$ $BaSO_4$ suspensions shows the mucosal pattern more clearly than the 0.35 and 1.05 $\mu$ $BaSO_4$ suspensions. The "Micropowder $BaSO_4$," which closely resembles the sample of 0.35 $\mu$ $BaSO_4$ (Fig. 1), gave similar results in the experimental animals. The visualization of the mucosal pattern with $BaSO_4$, U.S.P., was comparable to that with 0.5 $\mu$ $BaSO_4$.

In the human subjects there was a striking similarity between the different examinations of the same subject and a marked variation among the individuals.

A similar tendency was noted in the three dogs studied (Table I). An analysis of the data on resting secretions during four- to six-hour periods in these animals (Table II) shows that the dog with the highest score (Chin) had the lowest concentration of mucin and hydrogen ions, and also showed longer and more frequent periods of little gastric motility. It is interesting to note that this dog, which had consistently given the best patterns

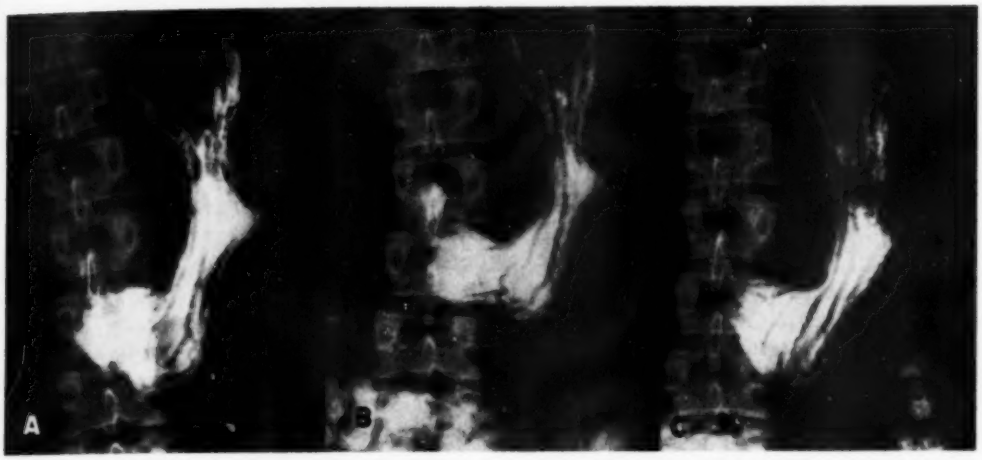


Fig. 3. Patient A. H.: Three separate examinations on consecutive days. A. 30 ml. of $BaSO_4$, U.S.P. B. 30 ml. of $BaSO_4$ 1.05 $\mu$. C. 30 ml. of $BaSO_4$ 0.5 $\mu$.

in the resting state, gave very poor results following the injections of both atropine and histamine.

The patterns of the remaining two dogs (Spot and Crip) did not vary following the injection of atropine, histamine, or insulin, in spite of varying changes in the values of mucin and acid.

## CONCLUSIONS

1. For the visualization of the gastric mucosal pattern in the dog under basal conditions, 0.5 $\mu$ $BaSO_4$ and $BaSO_4$, U.S.P., gave similar results.

2. Results with 0.35 $\mu$ $BaSO_4$, 1.05 $\mu$ $BaSO_4$, and "Micropowder $BaSO_4$" were not as good as with 0.5 $\mu$ $BaSO_4$ and $BaSO_4$, U.S.P.

3. Both in the animals and man there was a tendency toward similarity between the different examinations of the same subject and marked variation among individuals.

4. Visualization of the mucosal pattern could not be correlated with gastric secretory activity.

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(*Para el sumario en español, véase la página siguiente*)

SUMARIO

**Algunos Factores que Afectan la Visualización Roentgenológica del Patrón de la Mucosa de Tubo Gastrointestinal**

Estas investigaciones llevadas a cabo en perros y en el hombre tenían por objeto correlacionar el estado de la función gástrica en descanso, según lo indican factores tales como el pH, la producción de mucina y la movilidad, con el patrón de la mucosa revelado por las radiografías o la roentgenoscopia. No pudo establacerse ninguna correlación entre la actividad secretoria del estómago y la visualización del patrón de la mucosa.

Los experimentos en animales ejecutados en condiciones basales indicaron que el sulfato de bario de partículas de 0.5 $\mu$ y el de la F.E.U. daban resultados semejantes y mejores que los obtenidos con las otras preparaciones usadas, a saber, sulfato de bario de 0.35 $\mu$, sulfato de bario de 1.05 $\mu$ y sulfato de bario en "micropolvo" (Mallinckrodt).

Tanto en los animales como en los seres humanos hubo tendencia hacia la semejanza en los resultados de diversos exámenes en el mismo sujeto, pero decidida variación entre distintos individuos. En el hombre los patrones más constantes fueron observados en personas que tenían estómagos de tipo hiposténico.

DISCUSSION

**Ross Golden, M.D.** (New York, N. Y.): We have just listened to a very interesting discussion of an important problem. Radiologists for many years have observed differences in different individuals in the demonstration of the gastric mucosal pattern during routine clinical examinations of the stomach. I have used commercial barium sulfate suspended in normal saline and in many instances have demonstrated beautiful mucosal patterns. In other individuals I have not. This difference was not in the material but in the individual. Dr. Pirkey has shown that the same thing occurs in dogs. He and his co-workers are attempting to find out what makes this difference in individuals. One possibility is the degree of acidity or, in other words, the hydrogen ion concentration. As the title of the paper implies, there may well be other factors.

Some important observations on the distribution of barium sulfate in the small intestine have been made by Frazer, French, and Thompson[1] and by other observers in England, which might possibly have a bearing on Dr. Pirkey's problem.

We are indeed fortunate that this group is working on this problem, led by Dr. Pirkey, who is an astute observer and an energetic experimentalist. We wish them success.

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[1] FRAZER, A. C., FRENCH, J. M., and THOMPSON, M. D.: Radiographic Studies Showing the Induction of a Segmentation Pattern in the Small Intestine in Normal Human Subjects. Brit. J. Radiol. 22: 123-136, March 1949.

# Roentgenologic Observations in Hemorrhagic Fever[1]

MAJ. DONALD W. S. STIFF, M.C., U. S. A., and COL. GEORGE M. POWELL, M.C., U. S. A.

HEMORRHAGIC fever was first encountered by western physicians when it appeared among the United Nations Forces in Korea in 1951. Osaka Army Hospital served as a center for the treatment of this disease at that time. A comprehensive study of 300 observed cases with 9 deaths has been reported by one of us (1, 2). The purpose of this paper is to present the roentgenologic observations in hemorrhagic fever. To our knowledge, roentgenograms of patients with this disease have not previously been published in the literature.

Reviews of the Japanese and Russian literature (3, 4, 5) revealed reports of 491 cases of hemorrhagic fever from Manchuria and 125 cases from eastern Siberia between the years 1932 and 1944. No cases were reported after 1944 until the disease broke out in Korea during 1951. In that year, 1,016 cases were recorded among the United Nations Forces (6). During early Manchurian outbreaks, the Japanese called the disease Songo fever and other names, according to the region of occurrence, but in 1942 they officially adopted the name epidemic hemorrhagic fever (5). The Russians, on the other hand, referred to the same disease in Siberia as endemic hemorrhagic nephroso-nephritis (3, 4).

Although the Japanese and Russians (3, 4, 5) claimed to have furnished experimental proof that the disease is due to a filtrable virus, American workers, in spite of intense effort, have been unable to identify the causative agent (7).

## CLINICAL COURSE

The incubation period in hemorrhagic fever varies from seven to as long as forty-six days, with an average of two to three weeks. The course follows a common clinical pattern consisting of three fairly well defined phases, which one of us (1, 2) has termed the invasion, toxic, and convalescent stages. The invasion stage usually lasts from two to five days and is characterized by an acute onset with high fever, accompanied mainly by symptoms and signs common to acute febrile illness and laboratory studies which are generally within normal limits. The toxic stage usually begins from the third to the fifth day and lasts until the tenth to the fourteenth day of illness. Shock is common early in this stage and is followed by renal failure. A hemorrhagic diathesis, evidence of cerebral toxicity, and gastrointestinal disturbances occur throughout this entire period. The most significant laboratory findings are albuminuria, oliguria and hyposthenuria; azotemia with hyperpotassemia; leukocytosis, often with leukemoid reaction and atypical lymphocytes; hemoconcentration; rapid sedimentation rate; thrombocytopenia; prolonged bleeding time; and increased capillary fragility. The convalescent stage usually begins between the tenth and fourteenth day and lasts for as long as four months. Polyuria and hyposthenuria with inability to concentrate urine normally are the most prominent and persistent findings during this phase.

## PATHOLOGY

The pathological aspects have been completely covered elsewhere (2). Therefore, only the pulmonary findings, which are most closely related to the roentgenologic observations, will be presented in detail in this paper.

*General:* The most distinctive gross pathological changes were observed in the kidney, heart, and pituitary gland. The cortex of the kidney was pale and swollen, and the medulla was congested and hemor-

[1] From the Radiology and Medical Services, Osaka Army Hospital, Osaka, Japan. Accepted for publication in June 1953.

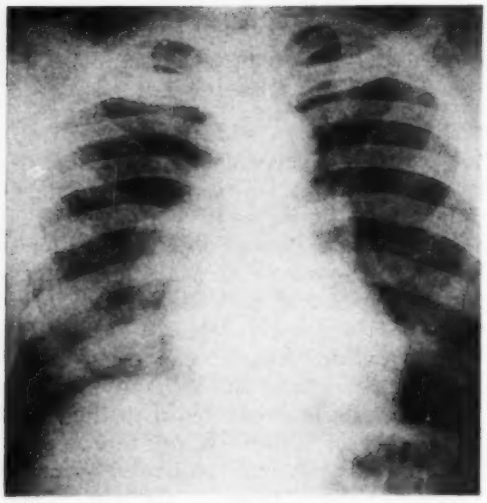

Fig. 1. Roentgenogram of the chest taken on the third day of illness, showing the early changes of hemorrhagic fever with dilatation of the pulmonary vessels and widening of the heart shadow.

rhagic. The right atrium of the heart showed hyperemia and diffuse subendocardial hemorrhage. The anterior lobe of the pituitary was soft, hyperemic, and hemorrhagic. The principal microscopic changes were: widespread vascular dilatation and engorgement with hemorrhage, particularly in the kidney, heart, pituitary, lungs, and gastrointestinal tract; focal necrosis in the pituitary, adrenal, kidney, and occasionally in the heart and liver; areas of mononuclear cell infiltration in the heart, kidney, liver, and pancreas.

*Lungs:* The lungs were generally heavier than usual. Edema and congestion with focal hemorrhages were frequent. The pleural cavities usually contained a small amount of clear or blood-tinged fluid. Scattered petechiae and ecchymoses were seen beneath the pleura. The cut surface was light pink to dark red in color, with focal to confluent areas of hemorrhage. The lung was usually firm and subcrepitant. Microscopically, focal hemorrhage was common; there was universal vascular dilatation and engorgement; many of the alveoli contained an eosin-stained exudate, and others red blood cells. Infiltration with polymorphonuclear neutrophils and lymphocytes was frequent in the peribronchial tissues.

## ROENTGENOLOGIC FINDINGS

Roentgenologic examination of the chest

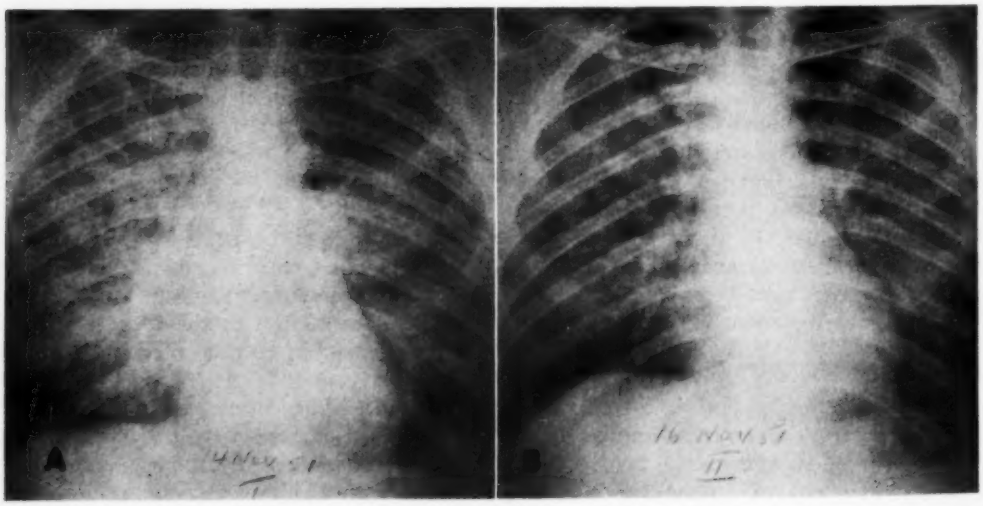

Fig. 2. A. Generalized patchy and linear areas of increased density fanning outward from the hili, with widening of the pulmonary vascular markings. There is relative radiolucency in the peripheral lung fields. Sixth day of illness.

B. Roentgenogram of the chest two days later, showing partial clearing of the lung, although numerous localized areas of congestion remain.

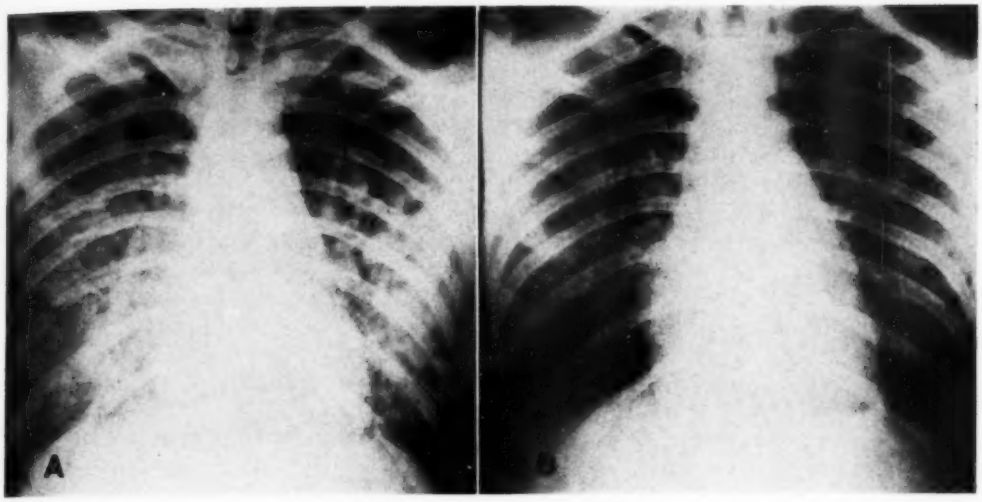

Fig. 3. A. Roentgenogram (portable) of the chest showing numerous areas of increased density bilaterally, chiefly central in distribution and partially confluent on the left. The pulmonary vessels are slightly enlarged. Tenth day of illness.
B. Chest film three days later, showing almost complete clearing.

performed on 181 patients during the invasion and toxic stages of the disease showed abnormal appearances in 26 patients. The findings were limited almost entirely to the chest; in 2 cases there was moderate generalized gaseous distention of the small and large bowel, the appearance suggesting adynamic ileus. In the chest the earliest findings were those of pulmonary vascular congestion with slight to moderate dilatation of the pulmonary vessels (Fig. 1). Evidence of peribronchial infiltration was also seen. Localized areas of consolidation, homogeneous in appearance and due to pneumonia, were occasionally observed. With increasing pulmonary congestion, multiple patchy areas of increased density appeared, often confluent and chiefly central in distribution (Figs. 2, 3, and 4). Terminally, pulmonary edema was extreme, with clouding of the lungs and almost complete obliteration of lung markings (Fig. 5). In addition to the central congestive changes, some of the patients showed areas of increased density elsewhere in the lungs which were probably not due to renal or cardiac failure but to focal areas of vascular congestion (Fig. 6). These latter findings are reported in the case history included in this paper and are distinctive for hemorrhagic fever. Patients who survived showed complete clearing of the chest, roentgenologically, within two to eight days.

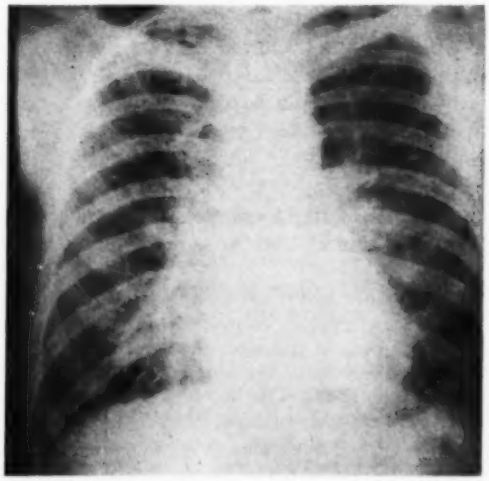

Fig. 4. Increased density and extent of hilar vascular markings, with linear and small stippled areas of increased density fanning outward from the hili. The heart shadow is slightly enlarged. The changes are those of pulmonary congestion. The patient died three days later, autopsy demonstrating focal areas in which the alveoli were packed with red blood corpuscles, with focal areas of atelectasis and edema. Roentgenograms were not taken just prior to death.

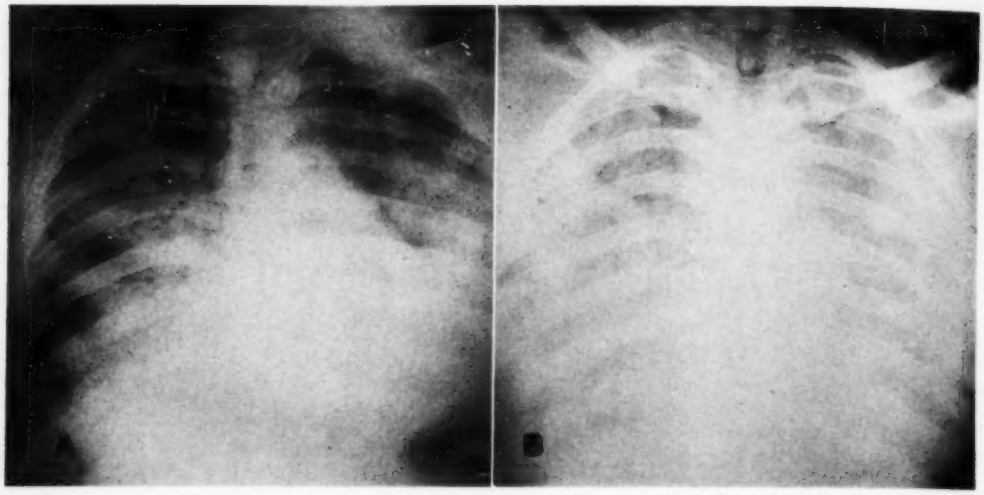

Fig. 5. A. Roentgenogram (portable) obtained during the toxic stage of hemorrhagic fever, showing extensive pulmonary vascular congestion, with numerous areas of pulmonary edema.
B. Examination one day later showed further development of pulmonary congestion and edema. The patient died the next day and autopsy demonstrated the presence of edema fluid in the alveoli, with dilatation and engorgement of the small blood vessels of the lungs. The alveoli in focal regions were packed with red blood corpuscles.

Pleural fluid was seen at the bases in several cases. The heart shadow was thought to be enlarged in some patients, although evaluation was difficult, as many of them were extremely ill and the roentgenograms were taken on the wards.

Intravenous pyelograms were not obtained during the acute phase of the illness. However, no abnormality was observed in the kidneys in patients studied late in the convalescent stage.

The following case report is representative of the clinical course and roentgenologic findings in hemorrhagic fever.

## CASE REPORT

*History and Physical Examination:* A 22-year-old Mongolian male of Hawaiian birth was admitted to Osaka Army Hospital on Nov. 20, 1951, as an air evacuee from Korea. He had been well until Nov. 17, when he experienced chills, fever, headache, backache, anorexia, and cough. Nausea, vomiting, and abdominal pain had appeared on the following day. On admission, on the fourth day of illness, the chills had disappeared but the other symptoms were still present. The temperature had reached 103.6° F. and 104.8° F. on the second and third day of illness, respectively. The blood pressure was 95/60 and the pulse 104 on the third day. Injection of the palpebral conjunctiva and pharynx had been noted since the second day.

On admission, the patient appeared acutely ill, extremely restless and prostrated. The temperature was 100° F., blood pressure 94/60, and pulse 100. The palpebral conjunctiva and the pharynx were injected and contained scattered petechial hemorrhages. There were abdominal and costovertebral angle tenderness and axillary adenopathy. The remainder of the physical examination was within normal limits.

*Laboratory Data:* The laboratory studies performed prior to admission here, including a urinalysis and a complete blood count on the second day of illness, were negative or within normal limits. A chest roentgenogram taken on the third day showed slight increase in peribronchial markings at the bases (Fig. 6A). The morning after admission, the fifth day of illness, laboratory studies were reported as follows: urine-volume 400 c.c. per twenty-four hours, specific gravity 1.026, albumin negative, no red blood cells, a few hyaline casts, sodium chloride excretion 1.04 gm. per twenty-four hours; hemoglobin 19.3 gm. per 100 ml., hematocrit 60 per cent, total leukocyte count 22,400, granulocytes 56 per cent with 20 per cent immature cells, small and large mononuclear cells 44 per cent with 12 per cent atypical lymphocytes; erythrocyte sedimentation rate 2 mm. in an hour (Westergren); blood nonprotein nitrogen 107.5 mg. per 100 ml., creatinine 5.2 mg., chlorides as sodium chloride 382 mg. The carbon dioxide-combining power was 36.6 volumes per cent.

*Course in Hospital:* On the fifth day of illness, headache became less severe and chills disappeared,

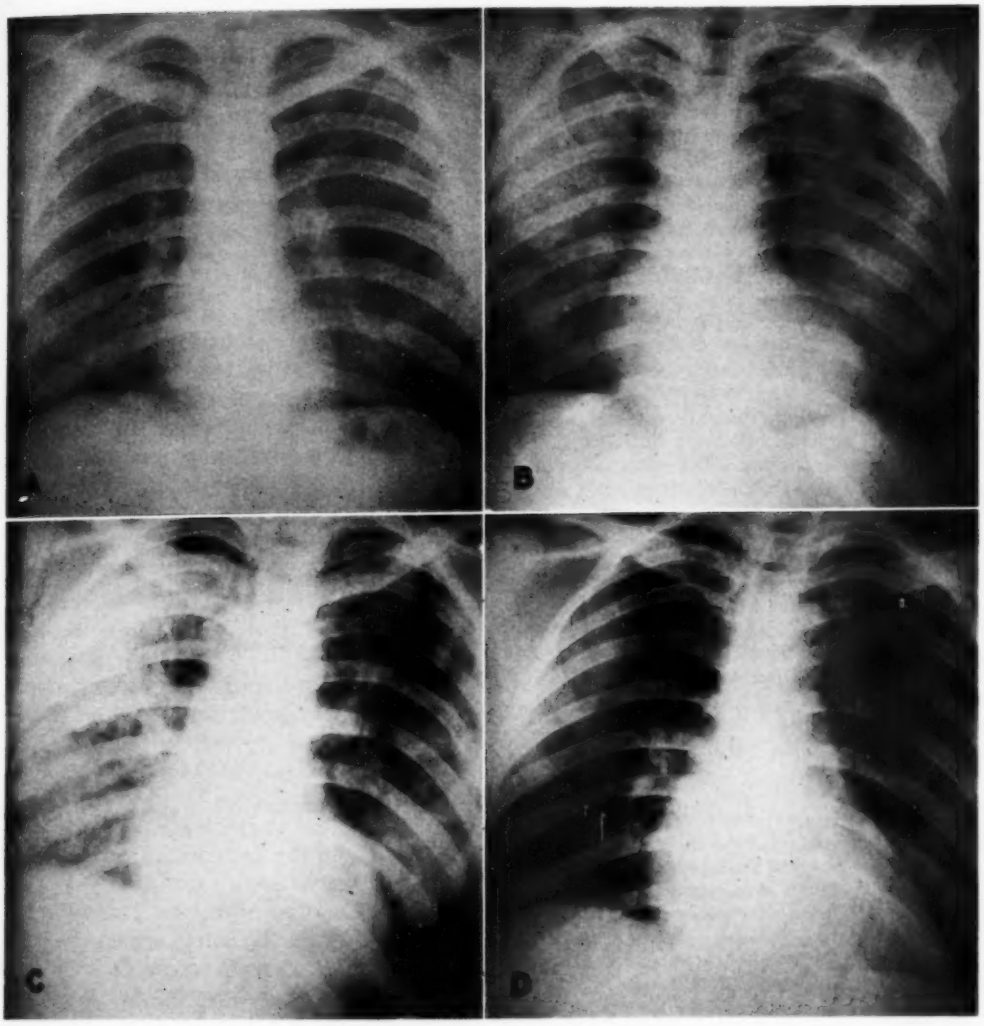


Fig. 6. A. Roentgenogram of the chest on the third day of illness, demonstrating slight increase in peribronchial markings in both lower lungs.

B. Large areas of increased density in the right upper and left lateral lung fields seen on the eighth day of illness. Numerous smaller areas of increased density are scattered elsewhere in the lungs. The hilar vascular markings are normal. The changes in the lungs are probably due to localized areas of hemorrhagic congestion. (Portable roentgenogram.)

C. Extension of the areas of congestion in the lungs, again with essentially normal hilar markings, seen on the ninth day of illness. (Portable.)

D. Almost complete clearing of the lungs on the eleventh day of illness. (Portable.) The case history of this patient is included in this report.

but vomiting and abdominal and costovertebral pain became more severe, persistent hiccups developed, and restlessness increased. The temperature was 100° F. The 24-hour urine output fell to 280 c.c.

On the sixth day, delirium developed, dyspnea appeared, and both fine and course râles were heard throughout the lungs. Urinalysis revealed a 24-hour volume of 200 c.c., a specific gravity of 1.015, 4 plus albumin, and many red blood cells. The hemoglobin decreased to 17.4 gm. per 100 ml. and the hematocrit to 50 per cent. The total and differential leukocyte counts and erythrocyte sedimentation rate remained essentially unchanged. The blood urea nitrogen reached 163 mg. and the chlorides fell to 348 mg. per 100 ml.

On the seventh day, there was no significant clinical change. The Rumpel-Leeds test became positive and there was anuria. The bleeding time was three minutes and blood platelets numbered 140,400 per cu. mm.

On the eighth day, the patient's condition remained unchanged. A chest roentgenogram showed numerous small and large areas of increased density in the lungs, peripheral in distribution, probably due to localized areas of hemorrhagic congestion (Fig. 6B). Urinalysis showed a specific gravity of 1.015, 4 plus albumin, many red blood cells, and a 24-hour volume of 1,070 c.c. The hemoglobin was 15.5 gm., hematocrit 46 per cent, and total leukocyte count 31,500. Peripheral smear showed 78 per cent granulocytes, with 9 per cent immature forms and 22 per cent small and large mononuclear cells but no atypical lymphocytes. The sedimentation rate rose to 34 mm. in an hour. Bleeding time increased to eleven minutes and the platelet count dropped to 52,000. Blood non-protein nitrogen was 155 mg. per 100 ml., creatinine was 8.3 mg., and chlorides 431 mg.

On the ninth day, the mental condition improved; delirium disappeared and was replaced by mental cloudiness. Vomiting subsided, but hiccups remained. Backache lessened slightly. The temperature was 98° F., blood pressure 114/80. Pulmonary râles were still marked. The 24-hour urine output increased to 4,400 c.c. A chest roentgenogram showed extension of the areas of hemorrhagic congestion in the lungs, with essentially normal hilar markings (Fig. 6C).

On the tenth day, the patient's general condition showed dramatic improvement. The only remaining symptoms were back pain and intermittent hiccups. The physical findings included mild mental apathy, moderate costovertebral angle tenderness, and scattered râles throughout both lung fields. Urine examination showed a specific gravity of 1.009, a trace of albumin, an occasional red blood cell, and a 24-hour volume of 5,200 c.c. Hemoglobin was 13.9 gm. per 100 ml. and the hematocrit 40 per cent. The total leukocyte count fell to 9,100, and the peripheral blood smear became normal. Sedimentation rate was 32 mm. in an hour. Bleeding time decreased to one minute and a half, and the platelets climbed to 340,000 per cu. mm. The blood non-protein nitrogen fell to 62.5 mg. and the creatinine to 2.5 mg. per 100 ml. Blood chlorides rose to 501 mg. per 100 ml.

From the eleventh to the eighty-eighth day of illness the patient showed gradual improvement. A chest roentgenogram taken on the eleventh day showed almost complete clearing of the areas of congestion in the lungs (Fig. 6D). At the time of discharge, all symptoms had disappeared and the physical and laboratory findings were negative or within normal limits. The inability to concentrate urine normally was the last of the abnormalities to disappear.

## DISCUSSION

It is not intended in this paper to present the roentgenograms in patients with hemorrhagic fever as diagnostic of this disease. They simply illustrate the roentgenographic changes seen in the chest during the course of the disease. In general, roentgenograms of the chest in hemorrhagic fever show evidence of pulmonary congestion beginning centrally at the hili and fanning outward, often associated with numerous peripheral areas of increased density due to focal vascular congestion. The central type of congestion is thought to be due primarily to renal failure of the lower nephron type, evidenced by oliguria with azotemia followed by polyuria and hyposthenuria. In these patients clearing of the chest, as seen on the roentgenogram, correlated well with improvement of kidney function.

## SUMMARY

The roentgenologic findings in hemorrhagic fever are presented. These consist of pulmonary congestion, both central and focal. The central type of pulmonary congestion is demonstrated by widening of the pulmonary vascular markings at the hili, with increased linear densities fanning outward into the lungs. Associated with this there may also be numerous patchy areas of congestion in the lungs which may be confluent. Cases were also seen in which focal areas of congestion in the periphery of the lung were present without evidence of hilar vascular congestion. Roentgenograms of the abdomen in two patients showed moderate gaseous distention of the small and large bowel, probably due to vascular congestion of the gastrointestinal tract and edema of the mesentery.

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Denver 8, Colo.

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SUMARIO

**Observaciones Roentgenológicas en la Fiebre Hemorrágica**

Descríbense los hallazgos roentgenológicos en la fiebre hemorrágica, aunque sin ofrecerlos como diacríticos de la enfermedad. Consisten en congestión, tanto central como focal. La forma central de congestión se pone de manifiesto por el ensanche de las marcas de los vasos pulmonares en los hilios, con aumento de las densidades lineales que se extienden en forma de abanico hacia afuera a los pulmones. Puede haber además numerosas zonas de placas congestionadas que pueden ser confluentes.

Obsérvanse además casos en que existen zonas focales de congestión en la periferia del pulmón sin signos de congestión vascular en los hilios. Las radiografías del abdomen en 2 enfermos revelaron moderada distensión gaseosa del intestino delgado y grueso, debida probablemente a congestión vascular del tubo gastrointestinal y edema del mesenterio.

La forma central de congestión débese, según se cree, primariamente a insuficiencia renal de las unidades inferiores del riñón, traducida por oliguria con azoemia, seguidas de poliuria e hipostenuria. En esos enfermos, el despejo del tórax, observado en la radiografía, correlacionó bien con el mejoramiento de la función renal.

# EDITORIAL

## Radiology in India

Radiologists in this country are reasonably well informed as to the status of our specialty and the accomplishments of our colleagues in the countries of Western Europe and South America, but our contacts with medicine in the Far East are relatively few. An opportunity to observe the practice of radiology in India was afforded to me through membership in a visiting team of medical scientists sponsored by the Unitarian Service Committee and the World Health Organization, whose aim was to bring to India some of the developments of Western medicine. Since achieving independence, India has come to be regarded as a powerful factor in world politics, perhaps because of the supreme contributions to religion and philosophy which have originated there. But in the realms of science and technology the achievements of this country are little known.

In any consideration of radiology in India, some orientation as to its medical practice must be achieved. Like many Eastern countries, the number of physicians in proportion to the population is dreadfully small. With 360,000,000 people there are less than 50,000 scientifically trained physicians. Over 80 per cent of the population lives in villages under relatively primitive conditions, so that scientific medicine is practised almost entirely in the cities. Some practitioners of an indigenous Indian medicine, entirely uninfluenced by the development of Western science during the last 200 years and consisting largely of the dispensing of herbaceous drugs, do give service in the villages, but real medical service to the farmer and villager is almost non-existent. There are only 22 reasonably good medical schools, many of these having a very small student body. In the cities, the standard of medical practice, largely following British methods, is good. But the economic aspects of medical service follow the pattern of the United States rather than that presently found in England. Thus, in a country which we are wont to think of as highly socialized, medical care is still largely on a private, voluntary basis, especially among the minority of the population in the middle and upper economic brackets. It is true that the extreme poverty of the masses of people, even in the large cities, makes necessary free medical services and hospitalization for the majority of people. But this is administered much as is the service given by the municipal hospitals in our own large cities. And, in fact, probably owing to the inability of the governmental bodies to support their hospital and medical schools, there are relatively few full-time physicians even in the teaching hospitals.

Radiology in India is led largely by men trained in Great Britain, although there are some exceptions. Some graduate work in this field has been in existence in the Indian medical schools for a number of years, and some of the younger radiologists received their early training at home. Many of them supplemented this training by further study in Britain, the United States, or in Western Europe.

The course of graduate study presently encompasses less than one year, and this is given in a few large institutions connected with medical schools or teaching hospitals. Despite the short period of training, the graduates are moderately well qualified. But there is no examining board in the sense of our Board of Radiology. Rather

the graduate is given a university examination in his own state which qualifies him for the degree of Doctor of Medical Radiology. Efforts are being made to lengthen the course of training. However, the combination of very inadequate compensation for the teaching and hospital positions, combined with the extreme difficulty of obtaining the expensive equipment needed for a private office, all of which must be imported, does not make radiology an attractive field for graduate study. Furthermore, in the whole country there are only some two hundred radiologists who have had training in the specialty. It is imperative that the number be rapidly increased; at the moment, therefore, it is impractical to lengthen the course of study. In this connection, it must be borne in mind that the Indian medical curriculum runs for five and one-half years, with a one-year internship in addition.

Despite India's dire poverty, every effort is being made to develop her medical institutions. But the rapid growth of the population, the sudden influx of large masses of refugees from Pakistan, and the extreme need for investment in agricultural and industrial improvement have made such progress in proportion to the demand and the need, inadequate. There are a few institutions which are well equipped and doing splendid work. For example, in Madras, the Barnard Institute of Radiology directed by Dr. K. M. Rai, a part of the Madras Medical College and the General Hospital, has a therapy department organized along British lines, superbly equipped in most respects, and doing a tremendous amount of work. Possessing its own operating room, its own clinical ward with a large number of beds for its own admissions, it is able to practise radiation therapy very effectively. The diagnostic section, however, is emphasized to a much lesser degree and is completely unable to cope with the pressure of its work. In Bombay, the Tata Memorial Hospital, largely devoted to the diagnosis and treatment of cancer, is a very well organized and well equipped institution connected with a large research institute, also devoted to cancer. The x-ray department, directed by Dr. K. P. Mody, is well equipped and of excellent caliber. In Bombay, also, as well as in a number of the other larger cities, there are several departments excellent in every respect. Unfortunately the opportunities for research and investigation are still meager, owing in large part to the shortage of personnel and the economic difficulties being experienced by all the teaching institutions.

The problems of radiology in India are astonishingly similar to our own, but perhaps even more intense. There is the same encroachment upon diagnostic roentgenology, not only by other specialists but by the general practitioner, possessing only a rudimentary fluoroscope. There is the same conflict between surgeon, gynecologist and radiation therapist. In general, roentgen diagnosis does not hold the same place in the mind of the general physician that it does here. There is much of the feeling, reminiscent of our own situation twenty-five or thirty years ago, that the roentgenologist is primarily a technician, turning out good roentgenograms for interpretation by others. Certainly this is rapidly changing, but advancement in the status of the specialty suffers from the very small number of hours devoted to radiology in the undergraduate years. The medical student is constantly confronted with various specialists in other fields expounding on roentgen diagnosis, while the small number of radiologists, working in the Medical Schools part time, carrying an enormous burden of clinical work from the massive public hospitals, are unable to teach adequately. Add to that the technical difficulties which result from the necessity for importing all equipment and materials used in roentgen diagnosis, the extremely hot climate, which makes preservation of film difficult, and the general lack of funds, and it is easy to understand the burden which the Indian radiologist carries.

It is heartening, therefore, to find the radiologist in India to be intellectually very superior, thoroughly aware of the current

of world literature in his field, attempting new ideas and methods, doing his best to improve the field within his limiting circumstances. Despite their small numbers, Indian radiologists have an active National Association which publishes a small but creditable quarterly journal, edited by Doctor Mody, the secretary being Dr. R. F. Sethna. It holds annual meetings which are vital and eagerly attended. The members are doing a reasonable amount of investigation, the details of which are too lengthy to be listed here. It should be pointed out that the Indian radiologist, like the Indian physician, has to contend with practically all the ills which beset people in this country but, in addition, has to be familiar with a great many more, especially in the field of tropical diseases. Such conditions as tropical eosinophilia, which simulates miliary tuberculosis, the calcified guinea worm, Madura foot, filariasis, echinococcosis, to mention but a few, we rarely, if ever, encounter. At the same time, cancer is a relatively common condition in India despite the fact that the average age of the population is but half of ours. Tuberculosis, of course, is seen in a violent and advanced form such as is now rarely seen here; it is extremely prevalent. In India, osteomyelitis and mastoiditis are still common conditions confronting the radiologist. One can learn humility by contact with our Indian colleagues and admiration for their accomplishments in the face of great handicaps.

There is in India today, despite the outcries of the politicians, a great desire on the part of the intellectual and scientific classes for closer relationships with the United States, a trend which most certainly we ought to encourage. It was disappointing, therefore, to find how American x-ray equipment was being displaced by German and British. In part, this is no doubt a reflection of the shortage of dollars in India. In part, however, it is the result of better and more energetic service on the part of non-American firms. The fondest hope of the Indian radiologist and of many medical students is to come to the United States for further training. Here, again, the foreign exchange situation and the high cost of living in this country militate against such travel. More important is our inability to find places for the Indian graduate student, at least such residencies as carry with them some stipend. So the students still go to Britain in large numbers.

India represents today almost one-fifth of the world's population. The probabilities are very great that this subcontinent will come to have a crucial position in world affairs in the future; it may well become the mediator between East and West, or perhaps may carry a balance of power which will preserve peace. For our own sake, perhaps for the sake of the whole world, it would be wise for us to keep in close touch and in harmony with the leaders of the Indian people. We can contribute our small part to this liaison by maintaining a continuous and pleasant contact with our colleagues in Indian radiology, by encouraging, within all possible limits, their visits to this country for observation or for prolonged study. By the mutual exchange of students, scientists, and ideas, much good may be accomplished.

LEO G. RIGLER, M.D.

# ANNOUNCEMENTS AND BOOK REVIEWS

## AMERICAN BOARD OF RADIOLOGY

Applications for the Spring (1954) examinations by the American Board of Radiology must be filed *not later than Dec. 1, 1953.* The examination will be held during the week of April 25.

B. R. KIRKLIN, M.D.
Mayo Clinic, Rochester, Minn.

## FLORIDA RADIOLOGICAL SOCIETY

The officers of the Florida Radiological Society for the current year are: Nelson T. Pearson, M.D., Miami, President; A. Judson Graves, M.D., Jacksonville, Vice-President; Hugh G. Reaves, M.D., Medical Arts Bldg., Sarasota, Secretary-Treasurer.

## KINGS COUNTY RADIOLOGICAL SOCIETY

The recently elected officers of the Kings County (N. Y.) Radiological Society are: President, Marcus Wiener, M.D.; Vice-President, Louis Goldfarb, M.D.; Secretary-Treasurer, Solomon Maranov, M.D., 1450 Fifty-first St., Brooklyn 19. The Society meets monthly, October to April (except December), at 9 P.M., at the Kings County Medical Society Building, Brooklyn.

## RADIOLOGICAL SOCIETY OF NEW YORK STATE

The most recent addition to the roster of state radiological organizations is the Radiological Society of New York State, organized at the last annual meeting of the State Medical Society. Dr. W. James MacFarland, Hornell, is President of the group; Dr. Percival A. Robin, Hempstead, Vice-President; Dr. Mario C. Gian, 610 Niagara St., Buffalo 1, Secretary-Treasurer.

## NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY

At the last annual meeting of the Northeastern New York Radiological Society, Dr. I. J. Murnane was elected President, Dr. John F. Roach, Vice-President, and Dr. Donald H. Baxter, Albany Hospital, Albany, Secretary-Treasurer.

## ROCKY MOUNTAIN RADIOLOGICAL SOCIETY

The officers of the Rocky Mountain Radiological Society for the ensuing year are as follows: President W. Walter Wasson, M.D., Denver, Colo.; President-Elect, A. M. Popma, M.D., Boise, Idaho; 1st Vice-President, Angus K. Wilson, Salt Lake City, Utah; 2nd Vice-President, Robert D. Moreton, M.D., Fort Worth, Texas; Secretary-Treasurer, John H. Freed, M.D., 4200 East Ninth Ave., Denver 7, Colo.; Historian, John S. Bouslog, Denver, Colo.; Members of the Executive Committee, Edward M. Hayden, M.D., Tuscon, Ariz., Thomas B. Bond, M.D., Fort Worth, Texas, and Maurice D. Frazer, M.D., Lincoln, Nebr. Dr. Frazer was also chosen a Counselor to the American College of Radiology.

## WESTCHESTER RADIOLOGICAL SOCIETY

At a recent meeting of the Westchester (N. Y.) Radiological Society, Dr. Theodore West was elected President, Dr. Frederick H. Lutz, Treasurer, and Dr. Charles G. Huntington, 170 Maple Ave., White Plains, N. Y., Secretary.

## BRITISH INSTITUTE OF RADIOLOGY ANNUAL CONGRESS AND EXHIBITION

The Annual Congress of the British Institute of Radiology is to take place on Dec. 10 and 11, 1953, at the Caxton Hall, Victoria St., London, S. W. 1. An interesting scientific program and a scientific exhibition, in the form of radiographs and pictorial and photographic material, have been arranged. The Mackenzie Davidson Memorial Lecture is to be given on the evening of the first day, and a dinner will take place on the evening of the second day.

Attendance at any part of the Congress, other than the Memorial Lecture, is restricted to those who have applied for registration as members of the Annual Congress. The fee for such registration is 10s/6d. for members of the Institute and £1.1s. for non-members. Registration forms may be obtained on application to the General Secretary, The British Institute of Radiology, 32 Welbeck Street, London, W. 1.

## CONFERENCE ON ELECTRONICS AND NUCLEONICS IN MEDICINE

Recent advances in the fields of radiology and motion picture fluoroscopy have led to the devotion of two complete sessions of the coming Sixth Annual Conference on Electronics and Nucleonics in Medicine to these subjects. The Conference will be held in the New Yorker Hotel on Nov. 19–20, 1953, in New York City. The afternoon session on Nov. 19 will feature papers on three-dimensional x-ray motion-picture technic, brightness intensification, x-ray microscopy and x-ray isodose plotting technics. In the evening of the same day, Mr. Sydney A. Weinberg of the University of Rochester and Strong Memorial Hospital will conduct a semi-popular type lecture and panel discussion on "Cinefluorography." Mr. Weinberg will discuss his three-

dimensional technics and also the impact that the new brightness intensifiers will have on this type of work. Some films will also be included showing the work that the Westinghouse Electric Corporation is doing in the field of brightness intensification. This session will be open to audience participation.

Three other regular sessions will be held, dealing with diagnostic procedures (multi-channel myography instrumentation, a precision stimulus monitor, location of tumors by ultrasonics and positron-emitting isotopes), blood measurements, and such fields of current interest as electroshock treatment in certain types of formerly fatal heart stoppages, application of the analogue computer to biological problems, and the dispersion of ultrasonic velocity in liquids.

For further information, address R. S. Gardner, Asst. Secretary, Technical Activities, CTO, American Institute of Electrical Engineers, 33 West 39th St., New York 18, N. Y.

## Letter to the Editor

### ACUTE PRIMARY PULMONARY BLASTOMYCOSIS

*To the Editor of Radiology*

DEAR DR. DOUB:

In a paper in RADIOLOGY (**54**: 157, 1950) by Dr. Chester P. Bonoff entitled "Acute Primary Pulmonary Blastomycosis," the author describes an "epidemic" of 23 cases of blastomycosis which supposedly occurred in Okinawa. In order to make clear our objections to the paper, it is necessary to state that blastomycosis occurs only on the North American continent (with the rare exception of a G.I. who is infected in the United States and may become sick overseas) and that no epidemics have ever been observed. In fact, man-to-man contagion appears not to exist.

Obviously the diagnosis of such a condition will be based on laboratory findings, and it is well known that in no fungous disease is the x-ray picture specific. With this in mind, it becomes quite obvious that the claim of an "epidemic" will be made or withdrawn according to substantiation of the laboratory diagnosis.

The culturing of *Blastomyces dermatitidis* from sputum is not often successful, and we dare to say that nobody ever has obtained twenty-three consecutive sputum cultures in the past. Therefore, it is extremely unlikely that a person who has not been trained specifically could culture *Blastomyces dermatitidis* twenty-three times.

It seems to us that the claim of an epidemic of 23 cases of blastomycosis occurring in Okinawa should be withdrawn unless additional proof can be presented concerning the character of the laboratory findings. There is no question in our minds that a respiratory infection of epidemic proportion occurred, but no proof exists that it was caused by *Blastomyces dermatitidis*.

The importance of the problem consists in the fact that only well documented cases should be acceptable for such unusual statements as the title and content of the paper imply.

Yours sincerely,

JAN SCHWARZ, M.D.
GERALD L. BAUM, M.D.

## In Memoriam

### ROSWELL T. PETTIT, M.D.

Dr. Roswell T. Pettit, long a member of the Radiological Society of North America, died at his desk on June 27, 1953. Although he had experienced repeated coronary attacks over the past fifteen years and suffered at times from severe angina, he was still active in the practice of his profession.

Dr. Pettit was born in Ottawa, Ill., the son of Dr. J. W. Pettit, and was a lifelong resident of that city. He studied at the University of Illinois and later at the University of Chicago, from which he received his M.D. in 1913. He interned at Peter Bent Brigham Hospital in Boston, following which he entered upon the general practice of medicine. During World War I, he served as lieutenant and later captain in the Medical Corps of the American Expeditionary Forces.

After a period of study in Europe, Dr. Pettit returned to his practice in Ottawa, specializing in radiology and in the study and treatment of cancer. In 1939 he founded the Illinois Valley Institute of Radiology, with which he continued to be associated until his death.

Dr. Pettit is survived by his wife, the former Dorothy Blatchford, whom he married in 1920, and by two daughters, Mrs. Frank O'Halloran and Mrs. James Kentmore.

## Books Received

THE RADIOLOGY OF BONES AND JOINTS. AN INTRODUCTION TO THE STUDY OF TUMOURS AND OTHER DISEASES OF BONE. By JAMES F. BRAILSFORD, M.D., Ph.D., F.R.C.P., F.I.C.S. (Hon.), Hunterian Professor, Royal College of Surgeons, England, 1934–35, 1943–44; Founder and First President of the British Association of Radiologists (now the Faculty of Radiologists); Emeritus Director of Radiological Studies in Living Anatomy, the University of Birmingham; Consulting Radiologist to the Queen Elizabeth Hospital, Birmingham, the Royal Orthopaedic Hospital, the Accident Hospital and the Warwickshire Orthopaedic Hospital, and other hospitals of the City; Active Fellow, British Orthopaedic Association; Awarded the Robert Jones Gold Medal and Prize of the British Orthopaedic Association, 1927, the Roent-

gen Prize, 1936, Encomienda Order Civil de Sanidad, Spanish Government, 1st Dallas B. Phemister Memorial Lectureship, University of Chicago, Hon. Socio Academia of Surgery, Madrid; Hon. Member University of Bordeaux; Hon. Member Roentgen Societies of Chicago, Detroit, New York, and Texas. Fifth Edition, with over 725 illustrations and 875 pages. Published by the Williams & Wilkins Co., Baltimore, Md., 1953. Price $19.00.

THE PHYSICS OF RADIATION THERAPY. By HAROLD ELFORD JOHNS, M.A., Ph.D., F.R.S.C., Professor of Physics, University of Saskatchewan; Physicist, Saskatchewan Cancer Commission, Saskatoon, Saskatchewan, Canada. Publication No. 116, American Lecture Series. A Monograph in the Bannerstone Division of American Lectures in Radiation Therapy. Edited by Milton Friedman, M.D., Associate Professor of Radiology, New York University Post-Graduate Medical School; Associate Radiologist, University Hospital; Attending Radiotherapist, Hospital for Joint Diseases; Visiting Radiation Therapist, Bellevue Hospital; Senior Consultant in Radiation Therapy, Veterans Administration Consultant, Walter Reed General Hospital; Consultant in Radiation, National Bureau of Standards and United States Public Health Service, Washington, D. C. A volume of 286 pages with 133 figures. Published by Charles C Thomas, Springfield, Ill., 1953. Price $8.50.

ROENTGEN-DIAGNOSTICS. By H. R. SCHINZ, W. E. BAENSCH, E. FRIEDL, and E. UEHLINGER. First American Edition (Based on the Fifth German Edition). English translation arranged and edited by JAMES T. CASE, M.D., D.M.R.E. (Camb.), Professor of Radiology Emeritus, Northwestern University Medical School, Chicago; Consultant in Radiology to the U. S. Marine and Passavant Memorial Hospitals, Chicago; Director, Memorial Cancer Foundation of Santa Barbara; Radiologist (Therapy), Santa Barbara Cottage Hospital, Santa Barbara, Calif. Volume III, Thorax. A volume of 1,116 pages with 1,085 figures. Published by Grune & Stratton, New York. Price $45.00.

TREATMENT OF TOXIC GOITER WITH RADIOACTIVE IODINE. By LINDON SEED, M.D., Director, Isotope Laboratory, Grant Hospital; Clinical Associate Professor of Surgery, College of Medicine, University of Illinois; and THEODORE FIELDS, M. S., Assistant Director, Radioisotope Laboratory, Hines Hospital; Certified Medical Nuclear Physicist, American Board of Radiology; Instructor in Radiology, Northwestern University Medical School. Preface by GEORGE V. LEROY, M.D., Associate Dean, Division of Biological Sciences, University of Chicago. A monograph of 116 pages with 17 figures and 6 tables. Published by Charles C Thomas, Springfield, Ill., 1953. Price $3.75.

SYMPATHIKUS CHIRURGIE. By PROF. DR. PAUL SUNDER-PLASSMANN, Direktor der chirurgischen Klinik und Poliklinik der Universität Münster (Westf.). A volume of 162 pages, with 145 illustrations. Published by Georg Thieme, Stuttgart, Germany, 1953. Agents for U.S.A.: Grune & Stratton, New York, N. Y. Price DM 54.—.

ATLAS D'HYSTEROGRAPHIE. By P. BROCQ, Professeur à la Faculté de Médecine de Paris; Chirurgien de l'Hôtel-Dieu; P. MOULONGUET-DOLÉRIS, Professeur à la Faculté de Médecine de Paris, Chirurgien de l'Hôpital Tenon; R. MARICOT, Attaché de Gynécologie à la Clinique Chirurgicale de l'Hôtel-Dieu; and H. HARTMANN, Attaché de Consultation de Gynécologie à l'Hôpital Tenon. A monograph of 104 pages with 140 figures. Published by Masson et Cie, Éditeurs. Libraires de l'Académie de Médecine, 120, Boulevard Saint-Germain, Paris (VI°), 1953. Price 1,440 fr.

L'UROKYMOGRAPHIE ET LA RADIOMANOMÉTRIE URINAIRE. By W. GREGOIR, Adjoint au Service d'Urologie de l'Université Libre de Bruxelles. A monograph of 226 pages, with 54 illustrations. Published by Masson et Cie, Éditeurs. Libraires de l'Académie de Médecine, 120, Boulevard Saint-Germain, Paris (VI°), 1953. Price 2,250 fr.

## Book Reviews

SECTIONAL RADIOGRAPHY OF THE CHEST. By IRVING J. KANE, M.D., Consultant in Chest Diseases, U. S. Naval Hospital, St. Albans, N. Y.; Attending Physician, Chest Diseases, Lincoln Hospital, New York, N. Y.; Associate Physician, Diagnostic Roentgenology, Montefiore Hospital, New York, N. Y. Foreword by EDWARD D. CHURCHILL, M.D. A volume of 154 pages, with 101 figures. Published by Springer Publishing Co., Inc., 1 Madison Ave., New York, N. Y., 1953. Price $7.50.

In four short chapters supplemented by more than a hundred illustrations, Dr. Kane has presented the technic of sectional radiography of the chest and sought to demonstrate its many advantages. He takes up in turn the general principles of the method, selection of positions and planes, anatomy, and pathology. The text is somewhat elementary, being rather on the student level, although it contains much useful information. The author believes

that planigraphy has three indications: diagnosis, localization, and evaluation of therapy.

Some 70 per cent of the monograph is devoted to illustrations which demonstrate the principles and methods of planigraphy and the anatomical and pathological aspects of the chest. In many instances conventional roentgenograms are presented for comparison with the planigrams in the same cases. This is the most valuable part of the work. It will prove useful to the student, radiologist, chest physician, and surgeon.

SLIPPED CAPITAL FEMORAL EPIPHYSIS. By ARMIN KLEIN, M.D., ROBERT J. JOPLIN, M.D., JOHN A. REIDY, M.D., and JOSEPH HANELIN, M.D., Massachusetts General Hospital, Boston, Mass. A monograph in American Lectures in Roentgen Diagnosis, edited by Aubrey O. Hampton, M.D., Chief, Department of Radiology, Garfield Memorial Hospital, Washington, D. C. A volume of 130 pages, with 230 illustrations. Published by Charles C Thomas, Springfield, Ill., 1953. Price $6.75.

To introduce their discussion of the slipped capital femoral epiphysis, the authors of this monograph devote some sixty pages to a series of roentgenograms of "normal" hips in children of various ages and both sexes, to serve as a standard for comparison with hips in which slipping is suspected. Not only is this an excellent introduction to what follows, but it is of itself a useful source of reference. Succeeding chapters, also well illustrated, are devoted to diagnosis and treatment of the slipped epiphysis, with details of surgical technic and postoperative care.

In a concluding chapter, the authors present their own results in 68 patients with 81 slipped capital femoral epiphyses, followed for nineteen months to twelve years. On this basis they state that an index of motion 90 per cent of normal and a 96 percentage of true normal function of the hip can be expected in early cases, in which the epiphysis can be nailed *in situ*, and an index of motion 85 per cent of normal and a 92 percentage of normal function in cases in which open reduction is required prior to nailing. For such results they outline the basic requirements as follows: For minimal slips, early diagnosis with nailing *in situ* and active weight-bearing on crutches within two weeks after operation assures the best results. For marked slips there are four cardinal points in the treatment. First, replacement of the head in its normal relationship with the neck should be effected only at the site of original displacement, namely, the epiphyseal plate. Second, the hip should be approached through an incision that gives sufficient exposure to permit replacement of the head. Third, the hip joint should be entered through a 2-inch incision across the capsule, over the anterior portion of the epiphyseal plate. Fourth, mobilization should begin as soon after operation as is practicable.

This is an excellent coverage of a limited subject. For the radiologist its greatest value lies in the wealth of good illustrative material.

TUMORS OF BONE. A ROENTGENOGRAPHIC ATLAS. Annals of Roentgenology, Vol. XXI. By BRADLEY L. COLEY, M.D., F.A.C.S., Attending Surgeon, Bone Service, Memorial Center for Cancer and Allied Diseases; Associate Professor of Clinical Surgery, Cornell University Medical College, New York; and NORMAN L. HIGINBOTHAM, M.D., C.M., F.A.C.S., Associate Attending Surgeon, Bone Service, Memorial Center for Cancer and Allied Diseases; Assistant Professor of Clinical Surgery, Cornell University Medical College, New York. A volume of 216 pages, with 172 figures. Published by Paul B. Hoeber, Inc., New York, 1953. Price $10.00.

As its title implies, this book is of value principally as an atlas displaying good reproductions of many of the forms of the principal bone tumors. The text is held to a minimum length. A section on "Non-neoplastic Conditions of Bone Simulating Bone Tumors" is included, but this contains little to interest the majority of radiologists. Only a few of the illustrations used appear in Dr. Coley's earlier book, *Neoplasms of Bone and Related Conditions*.

The book is recommended for those at the resident level and beyond.

COPYING AND DUPLICATING MEDICAL SUBJECTS AND RADIOGRAPHS. By H. LOU GIBSON, Technical Editor, Eastman Kodak Company, Rochester, N. Y. A monograph in American Lectures in Medical Photography, edited by Ralph P. Creer, F.R.P.S., F.B.P.A. A volume of 76 pages, with 37 illustrations. Published by Charles C Thomas, Springfield, Ill., 1953. Price $5.00.

The technical editor of the Eastman Kodak Company has prepared this small monograph for the instruction of those desirous of producing good slides and prints from all types of medical illustrative material—charts, drawings, and photographs, in black and white and in color. He sets forth the basic principles of technic for the various problems at hand and lists the equipment necessary to accomplish the desired result. Anyone with some photographic background who wishes to produce good copy for medical purposes will find this little book a most useful companion.

DIE ZEREBRALE ANGIOGRAPHIE. By H. KRAYENBÜHL, Professor für Neurochirurgie, Direktor der Neurochirurgie, Universitätsklinik Zürich, and Hs. R. RICHTER, Assistent der Neurochirurgie, Universitätsklinik Zürich. A volume of 218 pages, with 100 illustrations. Published by Georg Thieme, Stuttgart, 1952. Distributors for

the U. S. A. and Canada: Grune & Stratton, Inc., New York, N. Y. Price, DM 59.70.

In this well written textbook the authors cover comprehensively the field of cerebral angiography. The subject matter of the twelve chapters can be grouped into two main sections, the first comprising nine chapters (58 pages) and the second an atlas with 70 case reports.

A brief historical introduction is followed by a description of various procedures and x-ray technics employed in cerebral and vertebral angiography. In the third chapter, the anatomy of the vessels is discussed at length, illustrated by uniformly excellent roentgenograms and descriptive drawings. The authors make the statement that the capillary phase is of no special interest in angiographic diagnosis except as it is useful for ascertaining the velocity of the flow of blood through the vessels of the brain. In the second part of the book, however, there are presented some cases, such as meningiomas and metastatic lesions, outlined by the capillary phase, which not only delineates the location, size, and shape of the lesion but gives, in addition, an indication of its etiology.

In Chapter 4 the physiology of the blood flow through the brain vessels is discussed, and the authors state that a series of three stereoscopic views of the arterial, capillary, and venous phases are required for an adequate diagnosis. The indications and contraindications are evaluated in the fifth chapter. There is an apparent inconsistency between the statement of the authors that angiography does not adversely influence cerebral pressure, or produce edema of the brain, and a reference to investigations conducted by Broman and Olsson which indicated that the damage to the vascular wall produced by the injected medium might in some instances be the cause of cerebral edema. It seems that what the authors wanted to state was that cerebral angiography does not produce an increase in cerebral pressure with subsequent herniation and compression of the brain stem, as might be the case in ventriculography.

The vascular changes are described in the sixth chapter, with subdivision into extracranial and intracranial abnormalities, congenital and acquired.

The seventh chapter is concerned with the diagnosis and localization of space-occupying intracranial lesions. These are considered under two headings: A. Topographic Tumor Localization; B. Anatomo-pathological Diagnosis. In Section A the tumors are grouped according to their location and subsequent displacement of the cranial vessels due to direct or indirect pressure by the space-occupying mass. In Section B the arrangement is according to angiographic appearance—the distribution, location and shape of adjoining vessels, staining or lack of staining of the tumor.

In Chapter 8 hydrocephalus internus is described, and in Chapter 9 injuries to the cranial vault and brain, as extradural, subdural and intracerebral hemorrhages are considered. Chapter 10 contains an index of reproductions.

The second section of the book is in the form of an atlas with 70 case reports, each including a short clinical history, histopathological diagnosis, corresponding roentgenograms—often several views or phases of filling—and explanatory diagrams with descriptions of the roentgen findings. In one case only one lateral scout film of the skull is shown. Most of the films are lateral views. Although several postero-anterior projections are shown, the authors seem to rely mainly on lateral stereoscopic films. The roentgenograms and explanatory diagrams are of excellent technical quality.

An extensive bibliography, followed by a subject index, completes the work.

This textbook should be of use and interest to the neuroradiologist and neurosurgeon.

DER GESUNDE UND DER KRANKE KEHLKOPF IM RÖNTGENBILD. By PROF. DR. MED. C. R. GRIEBEL, Bad Nauheim. A volume of 172 pages with 156 illustrations. Published by Georg Thieme, Stuttgart, 1952. Distributors for the U. S. A. and Canada: Grune & Stratton, Inc., New York, N. Y. Price, DM 48.—.

This pictorial atlas of lateral roentgenograms of the larynx represents a collection of the author's cases and records for the years 1935–39.

After a brief introduction, the x-ray technic of lateral roentgenography of the larynx is described (the author mentions that anteroposterior views are adequately covered in an atlas published by Waldapfel). The remaining sections cover the normal larynx, the process of ossification, anatomical variations, various injuries and fractures of the larynx, cysts of the neck, acute edema of the larynx, abscess of the epiglottis, inflammations or suppuration of the floor of the mouth and retropharyngeal abscesses, syphilis of the larynx, tuberculosis of the larynx, and finally tumors of the larynx.

Sections dealing with injuries or diseases open with a short description of the anatomo-pathological findings and the roentgen appearance. Following these brief introductory comments, numerous cases are presented, each with a short history, clinical findings, roentgen findings, and diagnosis. The roentgenograms and descriptive drawings are of high technical quality and in some instances follow-up films, especially in the section devoted to tumors, are shown. A short bibliography up to the year 1939 is added.

The value of this atlas might be enhanced if anteroposterior and lateral laminagrams were added, since they have proved of great value in the diagnosis of laryngeal masses, especially in tumor clinics, where the exact location, shape and invasive characteristics of a malignant lesion before and after treatment can be followed by laminagraphy.

ENCYCLOPÉDIE ÊLECTRO-RADIOLOGIQUE: RADIODIAGNOSTIC (Volume II). By VARIOUS AUTHORS. Published under the direction of ROBERT COLIEZ, Médecin Êlectro-radiologiste des Hôpitaux de Paris. A volume of 709 pages with numerous illustrations. Encyclopédie Médico-Chirurgicale, 18, rue Séguier, Paris, 1953.

This large encyclopedia combines a moderate amount of descriptive text with an almost atlas-like collection of diagrams and roentgenograms. The binding is of the loose-leaf type. Each separate section consists of six to eight pages, with six to twenty roentgenograms. The material covered includes roentgen study of the skeleton as a whole (including the spine and skull), encephalography, otorhinology, stomatology, ophthalmology, and myelography.

General features of skeletal trauma and traumatic lesions of specific areas of the skeleton are discussed and illustrated. Roentgenograms made following various forms of therapy are shown. Malformations and osseous dystrophies of various portions of the skeleton are presented.

Tuberculosis of bone is systematically portrayed. Rheumatic affections are also extensively illustrated, with numerous examples of psoriasis and gout. Metabolic and parasitic diseases also merit separate sections. The section on bone tumors is followed by a consideration of segmental differential diagnosis of skeletal tumors.

More than one-third of this large tome is concerned with the head and neuroradiology in children and adults. This includes extensive coverage of tumors of the skull and its contents. The section on ventriculography includes anatomic diagrams and schematic portrayal of Lysholm's technic. Normal and abnormal air studies are profusely illustrated. Intracranial angiography is also illustrated with anatomic diagrams and reproductions of roentgenograms. The paranasal sinuses, mastoids, eyes, and jaws are briefly considered. The section on myelography is brief but well illustrated.

This text is intermediate in coverage between the standard brief textbook and the extensive presentation of monographs devoted to the various subjects. When one views the sections on the skeleton as a whole, the skull, encephalography, angiography, otorhinology, and myelography, the impression is gained that the principal diseases are illustrated by good typical cases, but that more detailed information may be obtained from monographs on these subjects. While this may be true, the evident purpose of presenting the general subject matter is achieved and the illustrations are good.

RADIOACTIVE ISOTOPES IN THE TREATMENT OF CANCER. By ENRICO VIA. Proceedings of the XVII National Congress of Medical Radiology (Italy), September 1952. A volume of 123 pages, with 23 illustrations. Published by Instituto per la Diffusione di Opere Scientifiche, Milan, Italy.

This book is the outcome of a visit to various medical centers in the United States under a grant from the World Health Organization. The author treats his subject in thirteen chapters, dealing in orderly succession with nuclear structure, physics of radioactive isotopes, biologic action of isotopes, measurements and dosimetry, the uses of $I^{131}$, radioactive phosphorus, colloidal metals, $Co^{60}$, plans for an isotope laboratory, disposal of radioactive waste, and protection.

The material discussed is well presented and well organized, and the printing and illustrations are excellent.

GASTRITI (STUDIO RADIOLOGICO). By LORENZO FELCI, Primario dell'Istituto di Radiologia dell' Ospedale Maggiore di Bergamo. Presented at the 17th National Congress of Medical Radiology, 1952, with the collaboration of Dr. Leopold Celli and Dr. Luigo Locatelli. A monograph of 246 pages, with 259 figures. Published by Istituto per la Diffusione di Opere Scientifiche, Milan, Italy.

This work is based upon the study of 171 patients in whom the radiological diagnosis was followed by gastroscopic control. For the gastroscopic work the author is indebted to Dr. L. Celli, and for the numerous pathological studies to Dr. L. Locatelli.

The book begins with a review of the literature on the comparison of radiologic and gastroscopic results. This chapter is particularly interesting because the author discusses very ably the statements of some gastroscopists regarding the value of x-ray diagnosis. This discussion he follows by a statistical analysis of his own observations.

The subsequent chapters deal with the radiological signs of gastritis in general, and specifically with antral gastritis, corrosive gastritis, phlegmonous gastritis, inflammatory swellings, tuberculosis, syphilis, giant rugae, and gastritis in pernicious anemia.

The book is well printed. The comments of the author are judicious and restrained, and the illustrations are excellent.

# RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

*Editor's Note:* Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Robert E. Fricke, M.D., Mayo Clinic, Rochester, Minn.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago 37.

**Alabama**

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

**Arizona**

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix. Annual meeting with State Medical Association; interim meeting in December.

**Arkansas**

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

**California**

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, H. R. Morris, M.D., 1027 D St., San Bernardino.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, George Jacobson, M.D., 1200 North State St., Los Angeles 33. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, H. B. Stewart, Jr., M.D., 2920 Capitol Ave., Sacramento. Meets last Monday of each month, September to May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, C. W. Bruner, M.D., 2456 Fourth Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, I. J. Miller, M.D., 2680 Ocean Ave., San Francisco 27. Meets quarterly, at the University Club.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, William H. Graham, M.D., 634 E. Santa Clara St., San Jose 12. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Wm. W. Saunders, M.D., VA Hospital, San Francisco 21. Meets third Thursday at 7:45, Lane Hall, Stanford University Hospital.

**Colorado**

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Wm. S. Curtis, M.D., Boulder Medical Center, Boulder. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

**Connecticut**

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer*, William A. Goodrich, M.D., 85 Jefferson St., Hartford 14. Meets bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, B. Bruce Alicandri, M.D., 20 Maple St., Springfield, Mass. Meets second Friday of October and April.

**District of Columbia**

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, Alvin C. Wyman, M.D., 5445 28th St., N.W., Washington. Meets third Wednesday, January, March, May, and October, at 8:00 P.M., in Medical Society Library.

**Florida**

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Hugh G. Reaves, M.D., Medical Arts Bldg., Sarasota. Meets in April and in October.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, E. Hampton Bryson, M.D., 273 Alhambra Circle, Coral Gables. Meets monthly, third Wednesday, 8:00 P.M., Veterans Administration Bldg., Miami.

**Georgia**

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Albert A. Rayle, Jr., M.D., 490 Peachtree St. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert M. Tankesley, M.D., 218 Doctors Bldg., Atlanta. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton Jr., M.D., University Hospital, Augusta.

**Hawaii**

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary*, Philip S. Arthur, M.D., Suite 42, Young Hotel Bldg., Honolulu. Meets third Friday of each month.

**Illinois**

CHICAGO ROENTGEN SOCIETY. *Secretary*, Elbert K. Lewis, M.D., 6337 S. Harvard Ave., Chicago 21. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, George E. Irwin, Jr., M.D., 427 N. Main St., Bloomington.

**Indiana**

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, John A. Robb, M.D., 23 East Ohio St., Indianapolis. Annual meeting in May.

**Iowa**

IOWA RADIOLOGICAL SOCIETY. *Secretary*, James T. McMillan, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and holds a scientific session in the Fall.

**Kansas**

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Willis L. Beller, M.D., 700 Kansas Ave., Topeka. Meets in the Spring with the State Medical Society and in the Winter on call.

**Kentucky**

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

**Louisiana**

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

RADIOLOGICAL SOCIETY OF LOUISIANA. *Secretary-Treasurer*, J. T Brierre, M.D., 700 Audubon Bldg., New Orleans.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

**Maine**

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Hugh Allan Smith, M.D., Eastern Maine General Hospital, Bangor. Meets three times a year—Spring, Summer, and Fall.

**Maryland**

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, H. Leonard Warres, M.D., 2337 Eutaw Place, Baltimore 17. Meets third Tuesday, September to May.

MARYLAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, H. Leonard Warres, M.D., 2337 Eutaw Place, Baltimore 17.

**Michigan**

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, E. F. Lang, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

**Minnesota**

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, John R. Hodgson, M.D., The Mayo Clinic, Rochester. Meets in Spring and Fall.

**Mississippi**

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John W. Evans, M.D., 117 N. President St., Jackson, Miss. Meets monthly, third Tuesday, at 6:30 P.M., at the Rotisserie Restaurant, Jackson.

**Missouri**

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, James E. McConchie, M.D., First National Bank Bldg., Independence, Mo. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Francis O. Trotter, Jr., M.D., 634 North Grand Blvd. Meets on fourth Wednesday, October to May.

**Montana**

MONTANA RADIOLOGICAL SOCIETY. *Secretary*, Grant P. Raitt, M.D., 413 Medical Arts Bldg., Billings. Meets annually.

**Nebraska**

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James F. Kelly, Jr., M.D., 816 Medical Arts Bldg., Omaha. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

**New England**

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, Stanley M. Wyman, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday, at the Harvard Club, Boston.

**New Hampshire**

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., 127 Washington St., Keene.

**New Jersey**

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Salomon Silvera, M.D., 921 Bergen Ave., Jersey City. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

**New York**

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 2. Meets in January, May, and October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Solomon Maranov, M.D., 1450 51st St., Brooklyn 19. Meets fourth Thursday, October to April (except December), at 9:00 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Frank Huber, M.D., 131 Fulton Ave., Hempstead, N. Y. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Jacob R. Freid, M.D., 1049 Park Ave., New York.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Donald H. Baxter, M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April. Annual meeting in May or June.

RADIOLOGICAL SOCIETY OF NEW YORK STATE. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo. Meets annually with the State Medical Society.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, A. Gordon Ide, M.D., 277 Alexander St. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary*, Charles G. Huntington, M.D., 170 Maple Ave., White Plains. Meets third Tuesday of January and October and at other times as announced.

**North Carolina**

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, Waldemar C. A. Sternbergh, M.D., 1400 Scott Ave., Charlotte 2. Meets in April and October.

**North Dakota**

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, H. Milton Berg, M.D., Quain & Ramstad Clinic, Bismarck. Meets in the Spring with State Medical Association; in Fall or Winter on call.

**Ohio**

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, M. M. Thompson, Jr., M.D., 316 Michigan St., Toledo. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Frank A. Riebel, M.D., 15 W. Goodale St., Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mortimer Lubert, M.D., Heights Medical Center Bldg., Cleveland Heights 6. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Chapin Hawley, M.D., 927 Carew Tower, Cincinnati 2. Meets first Monday of each month, September to June, at Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, W. S. Koller, M.D., 60 Wyoming St., Dayton. Meets monthly, second Friday.

**Oklahoma**

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Danstrom, M.D., Medical Arts Bldg., Oklahoma City.

**Oregon**

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John Wayne Loomis, M.D., 919 Taylor Street Bldg., Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club, Portland.

**Pacific Northwest**

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

**Pennsylvania**

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Herbert M. Stauffer, M.D., Temple University Hospital, Philadelphia 40. Meets first Thursday of each month at 5:00 P.M., from October to May, in Thompson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Donald H. Rice, M.D., 4800 Friendship Ave., Pittsburgh 24. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at Webster Hall.

**Rocky Mountain States**

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John H. Freed, M.D., 4200 East Ninth Ave., Denver 7, Colo.

**South Carolina**

SOUTH CAROLINA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*. William A. Klauber, M.D., Self Memorial Hospital, Greenwood. Meets with State Medical Association in May.

**South Dakota**

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Donald J. Peik, M.D., 303 S. Minnesota Ave., Sioux Falls. Meets during annual meeting of State Medical Society.

**Tennessee**

MEMPHIS ROENTGEN CLUB. *Secretary*, Harvey Thompson, M.D., 899 Madison Ave. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, George K. Henshall, M.D., 311 Medical Arts Bldg., Chattanooga 3. Meets annually with State Medical Society in April.

**Texas**

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, Claude Williams, M.D., Fort Worth. Meets monthly, third Monday, in Dallas odd months, Fort Worth even months.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Harry Fishbein, M.D., 324 Medical Arts Bldg., Houston 2.

SAN ANTONIO-MILITARY RADIOLOGICAL SOCIETY. *Secretary*, Hugo F. Elmendorf, Jr., M.D., 730 Medical Arts Building, San Antonio 5, Texas. Meets at Brook Army Medical Center, the first Monday of each month.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting Jan. 29–30, 1954, Dallas.

**Utah**

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

**Virginia**

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., 1308 Manteo St., Norfolk 7.

**Washington**

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John N. Burkey, M.D., 555 Medical-Dental Bldg., Seattle. Meets fourth Monday, September through May, at College Club, Seattle.

**West Virginia**

WEST VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, W. Paul Elkin, 515–519, Medical Arts Bldg., Charleston. Meets concurrently with annual meeting of State Medical Society, and at other times as arranged by Program Committee.

**Wisconsin**

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Jerome L. Marks, M.D., 161 W. Wisconsin Ave., Milwaukee 1. Meets monthly on fourth Monday at the University Club.

SECTION ON RADIOLOGY, STATE MEDICAL SOCIETY OF WISCONSIN. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee 2. Meets in October with State Medical Society.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursday at 4 P.M., September to May, Service Memorial Institute.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. W. Moir, M.D., Sheboygan Memorial Hospital, Sheboygan.

**Puerto Rico**

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# ABSTRACTS OF CURRENT LITERATURE

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## RADIOTHERAPY

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# ROENTGEN DIAGNOSIS

## THE HEAD AND NECK

**Calcification in Intracranial Neoplasms.** Franklin Martin, Jr., and Lloyd J. Lemmen. Am. J. Path. **28**: 1107–1131, November–December 1952.

Since the presence of calcium salts in intracranial neoplasms affords an accurate means of their localization on routine roentgenograms, the authors undertook a study of the histopathologic patterns of such calcification to provide a basis for interpretation of the roentgenographic appearances. For this purpose, 1,577 histologically verified intracranial tumors were reviewed. Calcification was found in 207, or 13.1 per cent, representing every major tumor group except the schwannomas and hemangioblastomas.

Four histologic patterns of calcification were differentiated. In Pattern I, the calcification occurs within blood vessel walls, in the form of small globules or calcospherites within the adventitia or media of the smaller vessels and the endothelium of the capillaries. In the more advanced stages the vessels are entirely calcified, appearing as solid cylinders. This was the pattern most frequently observed. Its highest incidence was in oligodendrogliomas (15 of 34 cases).

When the changes described as Pattern I involve adjacent blood vessels whose zones of necrosis overlap, concentric layers of calcium marking the former site of each vessel result in a conglomerate mass of calcium. This is designated as Pattern II. This was the pattern most infrequently encountered. It had a tendency to be associated with glioblastoma multiforme.

In Pattern III, calcium salts are deposited in an area of old hemorrhage or necrosis. A solid layer of calcium having irregular borders and no discernible vascular pattern is seen. This type was observed in 20 cases, of which 5 were ependymomas (5 of 55 ependymomas).

Pattern IV includes several types: (*a*) globules of calcium as seen within tumor cells; (*b*) calcification within the stroma of a tumor or its capsule; (*c*) calcific changes at the periphery of a tumor, but not related to (*a*) or (*b*). This pattern occurred in 85 tumors, chiefly craniopharyngiomas (39 of 58 cases).

Although no attempt was made to correlate microscopic calcification with roentgenographic shadows, a consideration of the three major histologic patterns, as demonstrated in this study, may occasionally aid in the interpretation of the roentgenogram. The first pattern gives rise to a flocculent or worm-like shadow resembling the vascular pattern as it appears on the arteriogram. The granules correspond to the cross section and the parallel radiations to the longitudinal view of the calcified vessels. The second and third patterns may appear on the roentgen film either as a single large shadow or as a solid sheet of calcium. Pattern IV does not cast a characteristic shadow.

Although radiologic diagnosis of the neoplastic type from the pattern of the calcium salts has not been attempted, this pattern, combined with pertinent clinical information, may suggest the true nature of the lesion. This information becomes useful, especially in children, in the interpretation of roentgenograms in the presence of symptoms of space-occupying lesions when calcium deposits are visible. In adults roentgenographic correlation with the histologic tumor type is more difficult.

Nine roentgenograms; 16 photomicrographs.

**The Radiological Diagnosis of Intracranial Tumours in Children.** James Bull. J. Fac. Radiologists **4**: 149–170, January 1953.

The author reviews 190 cases of intracranial neoplasms, all of which occurred under the age of sixteen years. In many cases it was possible to gain valuable preliminary information from the plain radiographs. The most important radiological signs are (1) suture diastasis, which even though minimal, may be of significance, and (2) decalcification of the sella, most commonly of the dorsum, with or without erosion. Suture diastasis is peculiar to childhood. It is seldom seen after the age of ten and practically never after the age of twenty. Conversely, sella decalcification or destruction is not striking in the first decade but is common in older patients with raised intracranial pressure.

Of the 190 cases, 66 were supratentorial, and 41 of these were within the cerebral hemispheres. About half of the tumors of the cerebral hemispheres showed calcification radiologically. Of the 17 non-calcified tumors in the hemispheres, 8 exhibited suture diastasis and 2 of these showed a decalcified sella. In 3 others evidence of increased intracranial pressure was demonstrable on the plain film. Included among the hemisphere tumors were 6 in the lateral ventricles. Eighteen Rathke pouch tumors were included in the study, only 1 of which failed to show calcification radiologically, thus supporting the opinion that nearly all craniopharyngiomas in children do calcify. Since these tumors may be large, it is necessary to make a wide search beyond the sella for streaks of calcium. Only 1 pituitary tumor was found, and 4 orbital tumors, of which 3 were gliomas of the optic nerve. All 3 optic nerve gliomas caused enlargement of the optic foramen; 1 case was bilateral with enlargement of both optic foramina.

In all but 9 of the 66 cases in the supratentorial group some evidence of a space-occupying lesion was seen on the plain radiograph and in nearly half it was possible to make a pathological diagnosis and to localize the tumor. No cerebral tuberculomas were found in the group.

Nine midbrain tumors were included in the series, of which none was calcified. Localization was therefore impossible by plain radiographs, although 6 cases showed pressure signs. Ventriculography gave accurate localization in all.

One hundred and fifteen tumors were contained within the posterior fossa. Only 6 of these were extracerebral, including 1 eighth-nerve neurofibroma, 1 meningioma, and 4 dermoids. Dermoids are interesting radiologically in that some produce a skull defect at the site of origin, most commonly in the region of the torcula. Of the intracerebral subtentorial tumors, none was calcified, and it was necessary to rely entirely on contrast studies for localization, although suture diastasis was often present. The author believes that pneumography is the method of choice, to be supplemented sometimes by positive contrast ventriculography, with Myodil. The chief sites of posterior fossa tumors are the pons, the cerebellar hemispheres, and the area between the cerebellar hemispheres in the midline. Tumors in this latter site are to be found posterior to the aqueduct and fourth ventricle, whereas pontine tumors are anterior to the aqueduct and fourth ventri-

cle. The most important posterior fossa tumors are the astrocytomas, in that they are amenable to surgery; they also form the largest group. Medulloblastomas are nearly as frequent as astrocytomas, but are malignant, invasive, and may seed into the cerebrospinal fluid system.

Forty-two roentgenograms. C. R. JONES, M.D.
Atlanta, Ga.

**The Pathology of Intracranial Tumours in Children.** Martin Bodian. J. Fac. Radiologists **4**: 171–174, January 1953.

Three-fourths of the tumors of adult life occur in the digestive, respiratory, and genital systems, whereas three-fourths of the tumors in children involve the nervous and urinary systems. In this paper a reclassification of the intracranial neoplasms of childhood is set forth, based on a series of 129 cases. Glial tumors comprised 89 per cent of the cases, including differentiating medulloblastomas, diffuse astrocytomas, nodular astrocytomas, and subependymal gliomas. The remaining 11 per cent included craniopharyngiomas, meningiomas, and choroid papillomas.

Nodular astrocytomas constitute the only intracranial neoplastic disease in childhood with a good surgical prognosis; 22 examples were included in this study, and of 18 patients whose tumors were totally excised, 14 have remained in perfect health for periods ranging up to ten years.

The author believes that the neoplastic cell does not reproduce itself indefinitely at the same stage of development, but is subje.t to the influence of two basic processes, differentiation and anaplasia, which accounts for variability of the tissue appearance of tumors of the same group and also for the variability from area to area and from time to time within a given tumor. Failure to appreciate these factors has led to overclassification of the many cytological variants and to unnecessary grading of tumors which happen to be in a particular stage of evolution at the time when symptoms draw attention to their presence.

It is unlikely that an accurate preoperative diagnosis can be made in any individual case, and it is impossible to distinguish a potential survivor before operation. It is therefore imperative to attempt to excise the tumor in nearly every case. In this series it was not possible to achieve a long-term survival in more than 20 per cent of the cases.

Two diagrams; 1 table. C. R. JONES, M.D.
Atlanta, Ga.

**Chronic Subdural Haematoma.** Harris Jackson. South African M.J. **27**: 83–84, Jan. 24, 1953.

The radiological features of chronic subdural hematoma are listed by the author as (1) elevation of the lesser wing of the sphenoid; (2) bulging of the greater wing; (3) forward bulging of the middle fossa; (4) enlargement of the same side of the cranium; (5) hypertrophy of the frontal and ethmoidal sinuses on the affected side; (6) thickening of the skull.

A case is presented demonstrating the first three of these signs. The patient was a girl eight years of age admitted for a single transient attack of weakness of the right hand, headache, and inability to speak, for forty-five minutes. Almost from birth it had been noted that the child was unable to move her right eye upward and that the left side of the head bulged. Examination showed the skull to be asymmetrical with bulging in the left temporo-parietal region. Looking up caused the right eye to turn upward and outward. There was poor control of the right arm.

Two roentgenograms are reproduced demonstrating the changes in the lesser sphenoid wing, greater sphenoid wing, anterior wall of middle fossa and thinning of the vault. Radiography following ventriculography showed a large quantity of air encysted over the left cerebral hemisphere. There was displacement of the ventricular system to the right, and the roof of the left lateral ventricle was depressed. A definite angle was noted between the septum pellucidum and the third ventricle. The right lateral ventricle was slightly dilated.

At operation a large subdural cyst was found, containing clear fluid, covering the entire surface of the left cerebrum and extending to the inferior and medial surfaces. The histologic features were consistent with those of the capsule of a chronic subdural hematoma. Recovery was uneventful.

Four roentgenograms. FRANK T. MORAN, M.D.
Auburn, N. Y.

**Treatment of Post-Pneumoencephalographic Headache with β-Pyridyl Carbinol Tartrate (Roniacol Tartrate).** R. M. N. Crosby. Am. J. M. Sc. **225**: 61–66, January 1953.

The headaches which follow pneumoencephalography have caused some concern on the part of those who use that procedure, and considerable discomfort to those subjected to it. Headache appears following injection of only small amounts of air; with maximum replacement of cerebrospinal fluid, it is severe and prolonged.

Post-pneumoencephalography headaches are probably of two varieties. The first, lasting approximately twenty-four hours, is a result of the irritant effect of the gas, as evidenced by pleocytosis of the cerebrospinal fluid. The second type is due to cerebrospinal fluid hypotension and is identical with the true post-spinal headache. It is this latter type which follows total replacement of cerebrospinal fluid with air and in which therapy is of considerable value.

The author administered Roniacol Tartrate to 38 patients, beginning twenty-four hours after air injection. By this means, the average duration of the headache was reduced from 4.3 days in a control group to an average of 1.7 days in the treated patients. Vomiting was well controlled when the drug was used orally but no apparent benefit was obtained when the medication was given intramuscularly.

Roniacol Tartrate is an analogue of nicotinic acid and is slowly converted to nicotinic acid in the body. It has no action on the cardiac rate or systemic blood pressure in the therapeutic levels and is therefore more suited to the present use than quaternary ammonium compounds or imidazoline derivatives. Only 9 instances of flushing or dizziness were encountered in over 300 doses of the drug. An interesting discussion concerning the effects of nicotinic acid on cerebral circulation is included.

Although favorable results were obtained in the small group of patients studied, with few side reactions, the author feels that no definite conclusions are as yet justified.

One table. LAWRENCE R. JAMES, M.D.
Boston, Mass.

**Hypopharyngeal Carcinoma in Sideropenic Dysphagia.** Nils Lindvall. Acta radiol. **39**: 17–37, January 1953.

Sideropenic dysphagia, also called Plummer-Vinson's syndrome, is a deficiency disease associated with a lack of iron or some closely related factor, either intrinsic or extrinsic, occurring almost exclusively in women. The most important findings, over and above the oft-recurring hypochromic anemia, are the various epithelial changes, such as rhagades at the corners of the mouth, atrophic changes in the buccal and pharyngeal mucous membranes, dysphagia, changes in the fingernails, fissuring of the finger tips, etc. The roentgen changes usually take the form of fold-like structures projecting inward from the anterior wall of the esophagus or hypopharynx.

A number of contributions have appeared on the association of sideropenia and hypopharyngeal cancer. Ahlbom, for example, found the Plummer-Vinson syndrome to be present in 90 per cent of patients with postcricoid carcinoma and carcinoma of the upper esophagus and in 50 per cent of those with oral carcinoma, from which he concluded that the secondary changes developing in the hypopharyngeal mucosa in sideropenia are precancerous in nature.

At the Karolinska Sjukhuset (Stockholm) there were seen, between 1940 and 1952, some 300 cases of hypopharyngeal carcinoma in women with a history of sideropenia. Of 10 patients adequately studied roentgenologically before the development of carcinoma, 8 showed typical sideropenic changes in the hypopharyngeal-esophageal region. These cases the author reports. They represent various types of sideropenic change. In 1 there was an elongated constriction in the upper esophagus. Two patients in the beginning had valve-like structures that subsequently became permanent, and 5 showed constant changes of a valve-like or constrictive type from the time of first examination.

In a further 41 cases roentgen studies were obtained after the diagnosis of carcinoma had been made. In 34 of this group sideropenic constrictions in the pharynx were demonstrated. In the great majority of the cases, these were found below the tumor either in close proximity to its distal part or separated from it by apparently tumor-free area. The constrictions themselves seem rarely to undergo malignant change.

Forty-eight roentgenograms. PAUL MASSIK, M.D.
Quincy, Mass.

**Roentgenographic Diagnosis of Tumors of the Glomus Jugularis.** Paul A. Riemenschneider, Gordon D. Hoople, David Brewer, David Jones, and Arthur Ecker. Am. J. Roentgenol. **69**: 59–65, January 1953.

A brief review of tumors of the glomus jugularis, many of which seem to have been reported as hemangioendothelioma, is followed by two case reports, with special attention to the roentgen findings.

Tumors of the glomus jugularis may be either benign or malignant. They erode into the middle ear rapidly and present as a bleeding mass in the external canal. With malignant lesions there are massive destruction of the petrous pyramid, involvement of cranial nerves, pressure on the brain stem, and a mass in the nasopharynx. The history is prolonged.

Roentgenographically the more benign tumors have been described as showing a sclerosis of the mastoid. In more advanced growths, the roentgenogram reveals the destruction of the petrous pyramid, showing marked loss of bone in the lower portion with the ridge remaining as a more or less intact shell. This was an outstanding feature in both of the authors' cases. In one of these an angiogram showed abnormal vascularization in the area of destruction. Other roentgen features were extreme upward displacement of the tentorium and distortion of the basilar and posterior cerebral arteries. In early cases the roentgen findings cannot be differentiated from those of chronic mastoiditis. Later, the roentgenograms assume more importance in relationship to the clinical history. Acoustic neurinoma may cause similar changes in the petrous bone.

Radiation therapy has been reported as yielding fair results, but radical surgical resection is the treatment of choice.

Ten roentgenograms; 2 photomicrographs.
GEORGE REGNIER, M.D.
University of Arkansas

## THE CHEST

**Tracheal Buckling: Differential Roentgen Sign.** Maxwell H. Poppel, Harold G. Jacobson, and Stephen B. Dewing. Arch. Otolaryng. **57**: 44–50, January 1953.

During the course of their work the authors consistently noted that unilateral upper lobe cancer was not associated with homolateral tracheal buckling, while inflammatory disease (usually tuberculosis) was. This difference was so striking that they began to use it routinely as a differential diagnostic feature.

Deviation of the trachea from its usual course is seen in many abnormal conditions. Deviation due to pressure from without, *e.g.*, from tumors, enlarged thyroid, thymus, lymph nodes, aneurysms, and tension pneumothorax, invariably presents a smooth gentle bowing, even when extreme. No mechanical basis for acute angulation exists, since the compressing masses are of a generally rounded configuration. Deviations caused by a pull, on the other hand, *e.g.*, in chronic fibrotic upper lobe inflammatory disease, atelectasis, thoracoplasty, and pneumonectomy, display all degrees of bending, up to and including marked angulation and buckling, depending generally on the severity of the fibrosis. The mechanical basis is, obviously, progressive gradual traction due to the shrinking action of scar tissue. Chronic tuberculosis, more than any other important infection, is associated with extensive and pronounced fibrosis.

A series of 263 cases of upper lobe bronchogenic carcinoma and 115 cases of unilateral upper lobe pulmonary tuberculosis were investigated. In 54.8 per cent of the 115 cases of tuberculosis there was well developed buckling of the trachea toward the involved side. In only 7 of the 263 cases of bronchogenic carcinoma of an upper lobe (without or prior to surgery) did buckling of the trachea occur (2.7 per cent). In 2 of these concomitant tuberculosis was found to be present. In the other 5 cases the buckling was due to massive atelectasis of the entire lung, secondary to main bronchial occlusion by tumor. In the remaining 256 cases either mild degrees of smooth bowing of the trachea (usually toward the lesion) were seen, or it remained in the mid-line. Rarely the trachea was bent smoothly toward the opposite side by the tumor alone or in combination with secondary metastatic mediastinal deposits. In no case of carcinoma free of tuber-

culosis or massive atelectasis was sharp tracheal buckling toward the lesion observed.

Nine roentgenograms.

**Pathologic Physiology of Cough.** S. Di Rienzo. Radiología **3**: 9–20, December 1952. (In Spanish). Also (in German) in Fortschr. a. d. Geb. d. Röntgenstrahlen **78**: 1–14, January 1953.

The diaphragm and the muscles of the thorax, while assisting in the production of cough, are not primary factors. Bronchographically, a transient irregular stenosis of the bronchus is seen; the bronchial lumen is reduced, in general, to a third of its maximal caliber and in certain areas almost to the point of obliteration. This is preceded and accompanied by a straightening out of the bronchial branches, especially those of second and third order (bronchial "erection").

All these findings suggest that a rise in endobronchial rather than endothoracic pressure accounts for the expulsion of bronchial contents. This is further indicated by the fact that the esophagus, when outlined with opaque material, is seen not to participate in the expulsive notion. Furthermore, there is no evidence of expulsion of blood from the pulmonary vessels, such as would be expected if expulsion of air during cough is assumed to be caused by compression of pulmonary tissue. In bronchiectasis, opaque material is expelled from the healthy but not from the dilated bronchi. This militates against cough being the passive result of endothoracic hypertension. Most convincing proof of the active nature of the phenomenon are the observations of cough limited to one lung or even one lobe.

Increase in caliber of the lumen in certain sectors cannot be accounted for by endothoracic hypertension, but the valve-like action of the functional stenosis explains how the increase in endobronchial pressure due to activity of one bronchial segment may be transmitted to another, less active one, resulting in its dilatation.

Anatomical studies show the bronchus to be rather rigid. The changes of the lumen, which is almost obliterated, and the waviness and deformity are due to changes in the mucosa. Only the mucosa has such erectile properties and is capable of almost instantaneous changes. The mucosal prolapses, invaginations, folding, and diverticula which appear and disappear during cough can be ascribed only to mucosal action; moreover, some of the phenomena observed during cough disappear on the application of vasoconstrictors and anesthetics, which act only on the mucosal coat. Serial bronchograms show well the wave, with definite amplitude and length, being propagated along the bronchial mucosa. Its high velocity precludes its recording by present radiologic means but it is possible to reconstruct it from serialograms.

Excellent bronchograms document this study.

[These observations have been previously recorded in the author's paper on *Bronchial Dynamism* in Radiology **53**: 168, 1949.—Ed.] J. BRACHFELD, M.D.
Philadelphia, Penna.

**The Value of Tomography in Examination of the Intrapulmonary Bronchi.** Herman Lodin. Acta radiol. Suppl. 101, 1953.

A detailed study of tomography as a means of examining the bronchi has been made by the author. He begins with a presentation of the principle of the Danatome, the instrument employed in obtaining tomograms, and includes a complete description of his technical methods.

Preliminary study of plexiglas models yielded valuable technical information. By use of the model it was found that optimum visualization could be obtained with 1 cm. between planes if the long axis of the model or bronchus were inclined 20–25° to the movement of the tube. A minimum wall thickness of 0.1 to 0.15 mm. could be reproduced if, in addition, the model formed an angle of not more than 15–30° with the plane in focus. Model experiments further demonstrated the significance of simultaneous changes in the angles between the long axis of the model and the direction of the movement of the tube, and between the axis and the plane in focus; the appearances in partial and total stenosis and the distinction between a stenosis and a bronchus leaving the layer; the effect of amplitude upon the tomographic reproduction.

The remainder of the study concerns the clinical application of these methods. Intrapulmonary bronchi in 30 normal subjects were demonstrable for a distance equal to roughly half that from hilus to long surface except for middle lobe and lingula bronchi, which were shorter, and posterior and lateral basal bronchi, which were longer. The smallest bronchi visible were 2 mm. in diameter.

Tomography of thickened bronchial walls, bronchiectasis, and bronchial stenosis is described in detail, and tomograms are reproduced.

The advantages and disadvantages of this method of examination of intrapulmonary bronchi are discussed. The author feels that it is a valuable aid in instances where bronchography is contraindicated.

The above constitutes only a rough outline of the material covered in this comprehensive study (109 pages). For detailed information the reader is referred to the original report.

Forty-seven figures. DORIS E. PIPKIN, M.D.
University of Louisville

**Angiopneumographic Diagnosis of Round Pulmonary Opacities.** P. Santy, J. Papillon, and J. C. Sournia. J. radiol. et électrol **34**: 12–17, 1953. (In French)

Isolated, round pulmonary opacities may be due to inflammatory disease or to benign or malignant neoplastic disease. Angiopneumography may not be of value when the lesions are very small, but in the presence of medium and large round opacities valuable information may be obtained by this method.

Inflammatory lesions do not create any arterial amputation and usually cause no appreciable vascular malformation. Malignant tumors produce a stenosis or arrest of an arterial ramus of the third or fourth order. Benign tumors stretch, displace, or distort arteries without occluding them and do not alter the neighboring arterial supply.

Seven roentgenograms; 2 drawings.

CHARLES NICE, M.D.
University of Minnesota

**Mass Screening Techniques for Chest Diseases. Industrial Medical Aspects.** O. Merton Derryberry. J.A.M.A. **151**: 112–114, Jan. 10, 1953.

A review of the results of the surveying of Tennessee Valley Authority employees is presented, with a discussion of the fundamentals of mass screening. From 1944 through 1949, a total of 76,358 films were made,

with employee participation varying from 71 to 90 per cent. The incidence of abnormality ranged from 1.3 to 6.2 per cent, a lower percentage being obtained when 70-mm. equipment replaced 35 mm. Reinfection tuberculosis constituted approximately one-half of the abnormalities seen.

From 1950 to 1952 official health agencies of Tennessee, Kentucky, and Alabama accounted for 9,677 additional examinations of TVA personnel. Both 70-mm. and 4 × 5-in. single films were used, with overall results roughly the same as in the surveys conducted by TVA itself.

The effective application of mass x-ray screening of the chest suggests consideration of multiple screening procedures as a tool of preventive medicine in industrial application. A pilot study covering 651 employees showed 49 per cent with abnormal conditions necessitating corrective action. Plans are underway for extension of these studies in TVA employees.

Two tables. WALTER M. WHITEHOUSE, M.D.
University of Michigan

**Mass Screening Techniques for Chest Diseases.** Arthur C. Christie. J.A.M.A. **151:** 114–117, Jan. 10, 1953.

Following a brief historical review of mass screening technics and a consideration of certain underlying organizational principles, the author proceeds to discuss some of the important knowledge resulting from about 50 million examinations made between 1946 and 1950, with particular emphasis on tuberculosis. Maximum benefit in follow-up is found when codes and tabulations are carefully prepared beforehand and placed in the hands of all concerned with records, so that they may understand what data are required. Uniform terminology is a necessity. The follow-up is greatly facilitated if the patient is carefully informed of the reason. All follow-up should be initiated at a central diagnostic clinic by an interview with a competent chest physician. The patient is then referred to a physician of his choice, who is advised of the findings at hand, and of the laboratory, social, and nursing services which are available.

No mass screening effort is considered complete until every person examined has received a final diagnosis and is assigned to a definite category for follow-up and treatment. An additional educational effect of the surveys is to point up the community need for adequate laboratory and hospital facilities.

Preliminary results of the Washington, D. C., community survey are presented. Fifty per cent of those eligible (*i.e.*, fifteen years of age and over) responded, 47 per cent of the eligible white and 53 per cent of the non-white population.

Projection of statistics to include the entire population indicates an estimated 10,500 residents with tuberculosis, 35 per cent unknown to the health department. One-fourth of both white and non-white tuberculosis patients were in the 10 per cent of the population fifty-five years of age or over, indicating that case finding must be directed with increasing intensity toward the older age groups, since only 39 per cent of these tuberculosis cases were known to the health department in contrast to 79 per cent of the younger age group.

The final report of the Washington survey indicates much to be done in the battle against tuberculosis and gives a sound foundation for future planning. It is emphasized that there is in every community a reservoir of this disease, indicating the need of stepping-up case finding and hospitalization programs.

WALTER M. WHITEHOUSE, M.D.
University of Michigan

**Bronchography in Chronic Lobar Collapse.** Richard C. Boyer. Am. J. Roentgenol. **69:** 28–41, January 1953.

When a lobe of the lung undergoes a decrease in volume, as by atelectasis after occlusion of the bronchus, there remains a certain amount of dead space in the pleural cavity within which is exerted a greater negative intrapleural pressure. Various compensatory phenomena come into play to obliterate the pleural dead space. Among the anatomical readjustments which can be seen by roentgenologic means are elevation of the hemi-diaphragm, narrowing of the costal interspaces on the involved side, shift of various mediastinal structures toward the involved side, and a variable degree of compensatory emphysema or compensatory expansion and reshaping of the remaining lobe or lobes. This paper is a study of the altered bronchial pattern in that portion of the lung which has undergone compensatory expansion and reshaping.

The bronchograms presented were taken from a review of approximately 350 Lipiodol studies. Each lobe of the lungs is reviewed separately, and representative bronchograms of the typical findings in each are presented, accompanied by labeled tracings which show the distorted bronchial pattern in that portion of the lung undergoing compensatory expansion.

The degree of bronchial rearrangement and distortion following collapse is roughly proportional to the volume of the collapsed lobe. Similarly, collapse of a division or a segment of a lobe will result in distortion of the bronchi in the surrounding lung proportionate to the volume of the collapsed segment. Actually, collapse of a single segment usually produces only slight bronchial distortion in the surrounding lung. Such segmental disease is recognized by absence of filling or abnormalities of the bronchi of the particular segment. It is only when a division (several segments) or a lobe is collapsed that a significant degree of bronchial rearrangement is detected on the bronchogram and that bronchial distortion presents a problem in interpretation.

The patterns following lobectomy closely resemble those resulting from collapse of the corresponding lobe.

Seven roentgenograms with accompanying tracings; 1 table. JAMES R. MORRISON, M.D.
University of Arkansas

**Dionosil—A New Contrast Medium in Bronchography.** D. I. Adler and M. H. Fainsinger. South African M. J. **26:** 913–918, Nov. 15, 1952.

Following a discussion of the advantages and disadvantages of three types of contrast medium previously used in bronchography—iodized oil, iodized oil with sulfadiazine, and a viscous solution of Diodone with methyl cellulose—the authors present their experience with a new type, Dionosil. This they have used in 28 studies on 25 patients.

Diodone has been compounded into a relatively insoluble ester of innocuous type and suspended in a water base, made more viscous by addition of a methyl cellulose derivative. The suspension obtained is iso tonic and non-irritant in comparison to the hypertonic

and irritating water-soluble compounds previously used. The medium is introduced through a thin rubber catheter in the trachea. Alveolar filling does not occur unless there is over-filling of the bronchi. Each lung requires about 15 c.c. for filling, and the medium coats the bronchial wall, producing a double-contrast effect.

There is no need for haste when using this preparation, and satisfactory films may be obtained up to forty-five minutes. The bronchi are still outlined in two hours, a faint amount remains in twenty-four hours, and almost none at all after three days.

The only sequela observed in the authors' series was pyrexia of brief duration, beginning three to four days after bronchography, in 5 cases.

Eleven roentgenograms.

M. HARLAN JOHNSTON, M.D.
Jacksonville, Fla.

**Alterations of the Bronchial System in Tuberculosis of the Lungs and Bronchi as Seen on the Bronchogram.** H. Anacker. Fortschr. a. d. Geb. d. Röntgenstrahlen **78:** 15–26, January 1953. (In German)

Bronchography in cases of pulmonary tuberculosis is indicated before surgery to get information in regard to: bronchiectasis and bronchostenosis (together with bronchoscopy), to reveal irreversible bronchitis-like alterations and their extent, and to determine the number and site of bronchi which drain cavities.

Streptomycin is given when bronchography is done, and water-soluble media are used. The bronchogram shows numerous alterations directly or secondarily due to tuberculosis. Primary and secondary changes cannot be distinguished from each other. The author describes changes in the course, contour, and caliber of the bronchi, changes in angles of division, and mucosal changes. In addition, cavities can be demonstrated. None of these changes exist separately, but all are present to some extent in most cases.

Thirteen roentgenograms.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

**Nodular Tuberculosis.** D. O. Shields, John S. Chapman, Jr., James Carswell, Jr., and O. J. Wollenman. J. Thoracic Surg. **24:** 568–575, December 1952.

The authors present a follow-up study of 140 cases of nodular tuberculosis of various types. All but 4 were followed for an average period of four years. The exceptions were tuberculomas, which were followed for at least six months.

Forty-nine cases were classified as residual nodules left from clearing tuberculous pneumonia. Forty patients in this group were discharged as having inactive disease; in 3 of these cases there was subsequent reactivation.

The second group included 31 cases in which the manner of development of the nodules could not be determined. All of this group were initially inactive, and 6 per cent later became unstable.

Nine of the 10 cases having inspissated cavities were inactive at the time of discharge, and 3 of these showed reopening of the cavity. Two of the latter patients had pneumothorax at the time of the reopening.

There were 4 cases of true tuberculomas, of which 3 were inactive; these neither increased in size nor became activated.

The final group consisted of cases showing multiple large nodules with little exudation and insignificant decrease in size with medical treatment. Of 46 cases in this category, 36 were inactive. Forty-seven per cent of the inactive cases became unstable.

Twenty-one per cent of all the cases which were inactive at the time of discharge later became reactivated. As is shown by the figures given above, the reactivation rate was high in the groups having inspissated cavities and multiple nodular lesions but relatively low in tuberculous nodules of unknown development and residual nodules of tuberculous pneumonia.

Nodular tuberculosis consists of solid tissue and therefore collapse therapy will have no effect on resolution of the nodules and will probably not decrease the chances of reactivation. Bed rest is of little effect. Antibiotics are of some value in clearing the slight exudation or reversible element.

A group of 30 patients who had resections for nodular tuberculosis at least one year previously were also studied. The reactivation rate for the group was 7 per cent. This small series suggests that resection may be valuable in those cases of nodular tuberculosis in which the reactivation rate has been high. The authors believe that the procedure should be restricted to cases with inspissated cavities and multiple nodular disease.

Twelve roentgenograms; 8 tables.

R. G. FORTIER, M.D.
St. Paul, Minn.

**Silicotic and Tuberculosilicotic Lesions Simulating Bronchiogenic Carcinoma.** Frederick G. Kergin. J. Thoracic Surg. **24:** 545–565, December 1952.

Patients with silicosis or tuberculosilicosis may have unilateral massive lung lesions without the usual roentgenographic picture of silicosis. These lesions most closely resemble bronchogenic carcinoma. The author presents 8 such cases. Seven patients whose symptoms also simulated bronchogenic carcinoma were operated upon, and the diagnosis of silicosis was confirmed by histologic study. These patients were all males and ranged in age from forty-nine to sixty-nine years of age. Five gave a history of prolonged exposure to silica and 2 of exposures of one and two years over thirty years earlier. One had worked in an underground mine without direct exposure. The symptoms of which the patients complained included pneumonitis, productive cough, hemoptysis, chest pain, weight loss, and shortness of breath.

Roentgenograms showed unilateral massive densities with a segmental distribution. Bronchial obstruction or stenosis was demonstrated in 6 of the cases by either laminagrams or bronchograms. Examination of the excised lung failed to show evidence of tuberculosis in 4 patients. Sputum examinations in the patient not operated upon were negative, and he was considered to have silicosis on clinical grounds. The 1 patient in whom operation was limited to biopsy later had a positive sputum. The 2 other patients had definite tuberculosilicosis.

The lesions of conglomerate silicosis and tuberculosilicosis cannot be distinguished from the gross appearance at operation. Characteristically the root of the lung shows a chronic type of inflammatory reaction, with enlarged lymph nodes which are firmly bound to vessels and bronchi by a dense fibrous tissue. The section of the bronchus to the involved segment in most cases shows compression and narrowing but not com-

plete obstruction. In one case a node was eroding the bronchial wall. Fibrosis is particularly marked around the bronchovascular bundles. The bronchi are compressed, the vessels sclerotic, and the lymphatic channels obliterated with microphages and black pigment. Masses of laminated hyaline material characteristic of silicosis are seen mixed with the fibrotic area. The cases of tuberculosilicosis show areas of caseation about the bronchi. The nodes adhering to and compressing bronchi showed a silicotic and not a tuberculous reaction.

The author suggests that the so-called conglomerate lesions of silicosis represent areas of obstructing pneumonitis due to partial or complete bronchial occlusion. The segmental bronchi become occluded in a dense fibrous tissue reaction which is formed around the silicotic lymph nodes. Some of these changes in the segments may be due to lymphatic obstruction, which prevents resolution of the inflammatory reaction occurring in a partially obstructed segment. The massive densities of silicosis occur when the lymph nodes are involved and produce a partial or complete obstruction of one of the bronchi.

The long latent period after initial exposure to dust is difficult to explain. It may be that subsequent infections increase the already existing lymphadenopathy to the point where it begins to obstruct a bronchus partially or completely.

In most of these cases it is necessary to do a thoracotomy to establish the diagnosis and exclude carcinoma. Segmental resection would be ideal; however, it is often difficult to rule out carcinoma grossly, and the adherence of the lymph nodes to the large vessels may cause great technical difficulty. The 5 patients of the present series treated by pneumonectomy are all well, though still short of breath on exertion.

The author suggests that this condition would best be called "chronic silicotic lymphadenitis with obstructive pneumonitis" (non-tuberculosus or tuberculosus).

Fifteen roentgenograms; 4 photomicrographs; 1 table.

R. G. FORTIER, M.D.
St. Paul, Minn.

**Sidero-Silico Tuberculosis in a Foundry Employee.** L. E. Hamlin. Dis. of Chest **23**: 81–89, January 1953.

A case of sidero-silico-tuberculosis is presented in a worker exposed to dust in a foundry. Roentgenograms of the chest revealed early nodular shadows throughout the lung fields and a density in the right upper lung. Over a period of seventeen years, the lesion in the right upper lung increased slowly in size and an additional lesion appeared in the left apical region. The localized lesion in the right lung was resected and revealed sidero-silico-tuberculosis with siderosis in the adjacent pulmonary parenchyma. In all probability the nodular shadows seen throughout the lung fields were due to deposits of iron oxide.

The author has observed 9 similar cases in workers whose occupational exposure to dust was the same as that in the case reported. In one instance a large cavity developed in the right upper lobe, but a concentrated sputum test and guinea-pig inoculations of gastric washings failed to disclose the presence of tubercle bacilli. The other 8 had shown no significant changes in the chest films over the past ten years.

Three roentgenograms; 1 photograph; 3 photomicrographs.

HOWARD L. STEINBACH, M.D.
University of California

**Baritosis. Report of a Case.** Eugene P. Pendergrass and Roy R. Greening. Arch. Indust. Hyg. & Occup. Med. **7**: 44–48, January 1953.

Baritosis results from inhalation of finely ground particles of barium sulfate. There is no respiratory incapacity, the only evidence of the condition being the roentgen demonstration of small, sharply circumscribed nodules evenly distributed throughout the lung fields. It is not often reported in America in spite of the large number of workers exposed to barium dust.

The authors present a case of baritosis and anthracosilicosis in a man who worked in a hard-coal mine in Pennsylvania and in a small lithopone plant where he was exposed to finely divided particles of barium sulfate. A diagnosis of silicosis was made on the basis of the original roentgenograms in this case, in 1936, and it was only after a careful occupational history was obtained, including evaluation of dust hazard, etc., that a presumptive diagnosis of baritosis was finally reached. The working conditions in the lithopone plant were modified, and within a short time the operation was completely discontinued.

The man died in 1948. At autopsy, the surface of the lungs had a gray-blue appearance, and there were diffuse and various-sized, firm, discrete nodules throughout each lung. The authors are still uncertain as to just how much the anthracosilicotic changes participated in the roentgenographic appearances, but they think that the baritosis alone could produce the changes found in the lungs of this worker.

Three illustrations, including 1 roentgenogram.

**So-Called Chronic Emphysema Bronchitis.** B. Steinmann and M. Schmid. Schweiz. med. Wchnschr. **83**: 103–108, Jan. 31, 1953. (In German)

Chronic emphysematous bronchitis, especially at an advanced age, is of great importance for the physician, partly due to its frequency and partly because of its therapeutic refractoriness, with concomitant social problems. It may be masked by other pathologic conditions, as bronchopneumonia or bronchiectasis.

The authors' experience with 26 patients ranging from fifty to eighty years of age (19 men and 7 women) is reported. In 21 of the cases, previous disease of the lungs, bronchi, or pleura was reported. Most of the men were workers in the open air, as farmers or the like.

In chronic bronchitis the main bronchi show crenulated contours in the bronchogram, with cystic enlargement of the mucous glands and protrusions of the bronchial wall. In the bronchi of medium or smaller lumen there are irregular enlargement and narrowing of the lumen, first of spastic and later of cicatricial nature, producing a "string-of-pearls" deformity of the bronchi and constituting the entity of deforming bronchitis.

Bronchiectasis appeared almost regularly in chronic emphysematous bronchitis and was generally diagnosed by bronchography. The authors, however, emphasize that auscultation should not be neglected in the diagnosis. Emphysema is, to a certain degree, a physiologic phenomenon of advanced years, but it may be aggravated by the presence of chronic bronchitis. Bronchial spasm and allergic complications occupy the limelight in many cases of chronic emphysematous bronchitis and produce the picture of so-called "asthmatoid bronchitis" in about 60 per cent of the patients. In about one-half of the patients eosinophilia was demonstrated.

Chronic emphysematous bronchitis leads to chronic cor pulmonale with cardiac insufficiency, which always forms a serious complication. Pulmonary stasis, therefore, is often found, which not infrequently may result in pulmonary edema. The heart was enlarged in one-half of the authors' patients. The interpretation of heart size must be done cautiously in an emphysematous thorax, since a dilatation of the heart, especially of the right ventricle, may extend anteriorly into the broad retrosternal space and therefore escape detection in the usual postero-anterior view.

A variety of bacteria could be shown in the sputum of the patients. The most common were streptococci (especially *Streptococcus viridans*), Pfeiffer's influenza bacilli, fusiform rods, and spirillae. *B. coli* and pneumococci were also frequently present.

The treatment of chronic emphysematous bronchitis must take into consideration the different pathogenic factors. The prognosis is serious in every case. Death is due for the most part to bronchial pneumonia and cardiac insufficiency. In two cases amyloidosis occurred in consequence of chronic purulent processes.

Six roentgenograms; 4 tables.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

**Bronchiectasis: A Comparative Study.** Joseph Gordon and Philip C. Pratt. Am. Rev. Tuberc. **67:** 29–44, January 1953.

A number of differences can be recognized when comparing tuberculous and non-tuberculous bronchiectasis by means of bronchography. In tuberculous bronchiectasis the site of involvement is usually in the apical and posterior segments of the upper lobes and occasionally in the superior segment of the lower lobes; the dilatation does not extend to the periphery of the lung in most cases, and the lumen of the involved bronchus tends to contract on expiration. In non-tuberculous bronchiectasis, the basal segments of the lower lobes, the right middle lobe, and the lingular segments of the left upper lobe are the usual sites of involvement; the dilatation tends to extend to the periphery of the lung and there is no change in the caliber of the diseased bronchi on expiration.

Additional information has been obtained by a study of removed lung tissue and correlation of the histopathologic findings with data supplied by injection of the arterial system and the bronchi with a contrast medium. In tuberculous bronchiectasis the pulmonary arterial system shows marked obliteration with fewer branches than in non-tuberculous disease, in which the vascular pattern is usually normal. The difference in bronchographic findings is also confirmed by this type of study. The marked pulmonary parenchymal involvement, with scarring and excavation demonstrated on sectioning the tuberculous lung, accounts for the obliteration of the vessels and peripheral portions of the bronchi.

In the course of the present study the authors noted that in some cases of cystic bronchiectasis (or cystic disease of the lung) the pulmonary arterial system was decreased in size and poorly developed. This suggests that the changes may be congenital, although it is possible that disease started early enough in life to alter the development of the pulmonary vascular system. Further study of similar cases may lead to more definite information regarding the pathogenesis of cystic disease.

Twenty-nine roentgenograms; 3 photographs; 4 photomicrographs.

JOHN H. JUHL, M.D.
Minneapolis, Minn.

**Bronchiectasis. A Bronchographic Study of Sixty Cases of Pneumonia.** Arnold L. Bachman, William R. Hewitt, and Henry C. Beekley. Arch. Int. Med. **91:** 78–96, January 1953.

Early bronchographic studies were performed on 60 consecutive pneumonia patients who had no history of previous pulmonary disease. Initial bronchograms were made as early as one week, and up to eight weeks, after the onset of the pneumonia. When bronchial change was demonstrated, the patient was kept under observation, and serial laboratory, bronchoscopic, and bronchographic examinations were performed.

Evidence of atelectasis was noted in the pneumonic infiltration in 38 of the 60 cases. Bronchial abnormality was noted in 25 cases. This consisted of slight dilatation and beading in 17 cases and marked bronchiectatic widening in 8 cases.

The occurrence of atelectasis was considerably higher in streptococcal pneumonia than in primary atypical pneumonia. Among the atelectatic cases, bronchopathy occurred in a significantly higher percentage of those due to streptococcal infection than of those due to primary atypical pneumonia. However, primary atypical pneumonia does cause bronchial abnormality in a considerable percentage of cases. Analysis of the material appeared to indicate that atelectasis does not cause bronchiectasis. Rather, both the atelectasis and the bronchiectasis resulted from a common factor, that is, inflammatory injury to the bronchus.

Serial bronchograms demonstrated a strong tendency for the abnormal bronchi to revert to normal.

Twenty-six roentgenograms; 6 tables.

HOWARD L. STEINBACH, M.D.
University of California

**The Duration of Carcinoma of the Lung.** Leo G. Rigler, Bernard J. O'Loughlin, and Richard C. Tucker. Dis. of Chest **23:** 50–71, January 1953.

The authors attempted to obtain certain information about cancer of the lung by tracing down chest roentgenograms made before the onset of symptoms or signs of the disease in a group of 264 proved cases of pulmonary cancer. With some difficulty, there were collected 50 histologically corroborated cases in which a roentgenogram accidentally antedated the advent of the identifying symptoms or signs. Of the 50 patients, 34 had died, 3 were still living but dying of the disease, and 13 had been operated upon, thus interrupting the normal sequence of events.

As a result of these studies, it was found that cancer of the lung had a greater duration from its inception until death than had previously been considered. In 37 inoperable cases, the average minimum duration of life was twenty-two and a half months. In 13 operable cases, the average minimum duration from the time of the first roentgen evidences until surgery was 36.4 months.

Roentgen signs of disease preceded the first symptoms by 7.8 months in patients who were not operated upon, and by 17 months in those patients who were treated surgically. Thus, in those patients selected for surgery the disease was either silent longer or was more favorable to early x-ray detection, or both, by an inter-

val of 9.2 months. Roentgen findings were usually present in the presymptomatic stages of the disease and almost invariably after the onset of symptoms.

The earliest roentgen changes observed were: (1) a nodular density in the lung periphery; (2) a solitary cavity or abscess in the lung parenchyma; (3) an area of infiltration along the vascular trunks; (4) unilateral enlargement of the hilar shadow; (5) segmental or lobar or even unilateral whole lung emphysema; (6) minimal areas of atelectasis, usually linear in type. The most frequent and apparent of these was an enlargement and irregularity of one hilus shadow.

Eight roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California

**Bronchogenic Carcinoma.** J. D. Trader and E. T. Odom. South. M. J. **46:** 12–14, January 1953.

Ten patients with bronchogenic carcinoma were admitted to the Veterans Administration Hospital at Tuskegee, Ala., in 1949 and 1950. All were beyond surgical help on admission. Eight of the patients showed variable areas of increased density in the lung fields. One patient had a massive left side pleural effusion with a mediastinal shift to the right. The tenth patient showed cardiac hypertrophy and dilatation with congestive changes that obscured the carcinoma. The authors discuss the various aspects of the disease, with special emphasis upon the non-specificity of subjective symptoms and the value of x-ray examination.

Two roentgenograms.

JOHN M. KOHL, M.D.
Jefferson Medical College

**Comparative Study of Ventilation and Circulation in Bronchopulmonary Cancers.** R. Kourilsky, D. Brille, M. Marchal, and C. Hatzfeld. J. franç. méd. et chir. thorac. **7:** 1–17, 1953. (In French)

The ventilatory capacity of the lungs or portions of the lungs may be studied in various ways. A gross estimation may be obtained during fluoroscopy and by comparing roentgenograms made in inspiration and expiration. Bronchospirographic studies, including determinations of vital capacity, maximum minute ventilation, and other factors, may also be of aid. Another method, "statidensigraphy," consists of estimating the relative densities obtained in inspiration and expiration as registered graphically by amplification of the current picked up by a photo-electric cell attached to a fluoroscopic screen. The latter method is similar to cinedensigraphy, by which densities due to circulatory changes in the lungs are graphically recorded. In "statidensigraphy" a roentgen beam of lesser intensity is utilized and the electrical circuit is modified.

In this study cinedensigraphy was the principal method used to study the status of the pulmonary circulation. [Apparently angiopneumography was not used.—C. N.]

It is shown that, as a general rule, the defect of circulation is comparable to the defect of ventilation, or surpasses it. It is possible to find a normal ventilation in pulmonary zones deprived of all circulation. The extent of the radiologic image and bronchoscopic findings do not permit one to estimate lymphatic invasion and operability. Estimation of ventilation scarcely improves the situation. The extent of faulty circulation reflects much better the extension of the neoplasm.

Eight roentgenograms, with accompanying cinedensigrams; 2 bronchospirograms.

CHARLES NICE, M.D.
University of Minnesota

**The Roentgenological Appearance of Parenchymal Involvement of the Lung by Malignant Lymphoma.** Laurence L. Robbins. Cancer **6:** 80–88, January 1953.

The importance of accurate diagnosis of pulmonary lymphoma lies in the possibility of surgery being selected as a therapeutic measure. When the disease takes the form of lymphatic involvement, infiltrative processes, and multiple nodular lesions, the attack is not likely to be surgical. When, however, lymphoma presents as a large solitary mass within the lung, either as its primary sign or as a late development, the decision must be made as to whether surgical extirpation is the treatment of choice. The present study was undertaken to determine, if possible, the roentgen-ray signs by which parenchymal involvement of the lung may be recognized.

Parenchymal involvement of a sufficient degree to be recognizable roentgenographically was found in approximately 47 per cent of 715 patients with malignant lymphoma treated at the Massachusetts General Hospital in the years 1944–51. In 5 cases the involvement was demonstrable as a solitary mass, occupying space equivalent to a segment of a lobe or nearly an entire lobe. Lesions of this type are not readily differentiated from bronchogenic carcinoma, sarcoma, a solitary metastasis, an occasional lung abscess, or even pneumonia.

In 33 cases the pulmonary involvement was in the form of nodular lesions, single or multiple, ranging from 3 or 4 mm. to 5 cm. or more in diameter. The nodules differ somewhat in shape from metastatic lesions, varying from ovoid to roughly triangular. Those located against the pleural surface may be confused with infarcts. Actual cavitation may occur in lymphomatous nodules; after treatment, whether by irradiation or chemotherapy, healing may result in a linear scar.

Five patients showed an infiltrative pneumonic type of process, with massive involvement of a lobe or lung, indistinguishable from consolidation of inflammatory origin.

The remaining 4 cases in the series showed a diffuse process resembling lymphatic spread of metastatic cancer and indistinguishable roentgenographically from other lymphatic processes.

There was no apparent correlation between the roentgen-ray classification and the prognosis or histologic type of the disease.

Fifteen roentgenograms; 2 tables.

**Concurrent Lymphoma of the Lung and Stomach. Follow-Up on a Previously Reported Case.** Paul L. Shallenberger, Peter Fisher, William C. Beck, and Charles H. DeWan. J. Thoracic Surg. **24:** 637–641, December 1952.

The authors report a case of concurrent lymphoma of the lung and stomach. The patient's initial illness was characterized by epigastric pain, nausea, weight loss, and evidence of intestinal bleeding. At that time an ulcer of the greater curvature of the stomach was found on x-ray examination, and a gastroscopic biopsy showed findings suggesting that it was benign. On the same admission a routine chest film revealed a discrete,

smoothly rounded opacity in the lower lobe of the right lung about 6 cm. in diameter. The pulmonary lesion was removed and on microscopic study was believed to be a benign lymphoma.

The gastric ulcer healed promptly, without recurrence through the next two years. At the end of that time the patient again had an episode of epigastric distress with passage of black stools for several days. A roentgenogram at this time showed a thickened irregularity of the greater curvature not truly rigid and without an apparent crater. Gastroscopy disclosed an ulcer, and a biopsy showed round-cell infiltration and marked inflammatory reaction. A subtotal gastric resection was performed, and the microscopic appearance was exactly similar to that of the lymphoma previously removed from the lung.

Examination of the original gastric biopsy specimen suggested that the lymphoma was present in the stomach at the time of thoracic surgery. The questions arise whether this is a case of primary lymphoma of the stomach and lung, whether the tumors developed simultaneously, whether they are part of a generalized lymphomatosis. The clinical course thus far has been benign.

Two roentgenograms; 3 photomicrographs.

R. G. FORTIER, M.D.
St. Paul, Minn.

**On the Natural Regression of Pulmonary Cysts During Early Infancy.** John Caffey. Pediatrics **11:** 48–64, January 1953.

This paper reports prolonged clinical and roentgen studies of 13 cases in which cystic roentgen changes were demonstrated in the lungs or pleural spaces before the sixth month of life.

When cysts are demonstrated roentgenographically in the lungs of infants younger than six months, they are commonly attributed to congenital anomalies and are removed surgically in the belief they are naturally irreversible. The author has found, on the other hand, that spontaneous regression is the rule for pulmonary cysts, even when they are demonstrated during the first weeks and months of life. He believes that all patients should be watched for a long period in the hope that a complete spontaneous regression will occur. The only exception to this policy is the rare case of an acute respiratory obstruction due to sudden and marked expansion of the cyst; in such an event, surgical excision is urgent and appears to be a life-saving measure.

In all of the 13 cases considered here, the cysts regressed without surgical treatment. In the youngest patient triple large cavities were present on the fifteenth day of life, replacing pneumonic consolidation which had been visualized on the seventh day. During the periods of observation, these infants grew and developed normally and did not suffer unduly from respiratory infections.

Five examples of air cysts are described in which the air appeared to be trapped in the pleural spaces during the course of pleural infections. The similarity of the roentgen findings in these cases to those in intrapulmonary air cysts makes differentiation difficult.

In 4 cases of massive pulmonary emphysema without visible cyst formation, lobectomy was found necessary in one and pneumonectomy in another. These were the only cases treated surgically in the entire group.

The high incidence of cysts during infancy and early childhood does not necessarily mean that they are of prenatal development. In a radiologic study of 5,000 unselected newborn infants the author found no instance of roentgen changes suggestive of cystic disease.

It is concluded that the immediate and ultimate prognosis of pulmonary and pleural cysts, untreated surgically, is excellent, even during the early weeks of life.

Thirteen case reports are included, with 38 roentgenograms, and 1 schematic drawing.

A. WILSON BROWN, M.D.
Shreveport, La.

**Factors Responsible for the Frequency of Right Middle Lobe Disease.** F. Peltzer. Fortschr. a. d. Geb. d. Röntgenstrahlen **78:** 27–37, January 1953. (In German)

The author discusses the anatomical structure and position of the right middle lobe, which determine the predilection of chronic infection and atelectasis for this structure. Atelectasis of the middle lobe in childhood is often due to enlarged lymph nodes. This process is completely reversible. In adults, on the other hand, atelectasis of the middle lobe is frequently not reversible because of inflammatory and stenosing processes in the middle lobe bronchus. The lobe contracts and decreases considerably in volume.

One case of carcinoma of the middle lobe is included in the report, on account of its rarity. Only about 3 per cent of cases of bronchial cancer are found in this location.

Nine roentgenograms; 1 drawing

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

**Loeffler's Syndrome Following Penicillin Therapy.** Seymour Reichlin, Mary H. Loveless, and Ernest G. Kane. Ann. Int. Med. **38:** 113–120, January 1953.

Although an allergic basis has been postulated for Loeffler's syndrome, few cases are reported in which a temporal relation to a specific allergen has been shown. A case is here recorded which demonstrates the production of marked pulmonary infiltration and eosinophilia following sensitizing doses of a penicillin preparation.

A 26-year-old college student with a positive serologic test for syphilis was treated by injections of procaine penicillin. Two years earlier he had taken penicillin lozenges for a mild sore throat. A serum sickness type of reaction appeared, manifested by fever and urticaria. Roentgenograms revealed patchy areas of pulmonary consolidation, and the eosinophil count rose as high as 80 per cent. Skin tests carried out after the patient's recovery, but while the eosinophilia was still marked, indicated that these manifestations may have been attributable to the penicillin.

This type of reaction to penicillin is rare, though cases have been reported by Falk and Newcomer in two patients treated for secondary syphilis (J.A.M.A. **141:** 21, 1949), and Harkavy observed a similar situation following penicillin therapy for asthma (personal communication). Other allergic responses described in the literature include urticaria, angioneurotic edema, and occasionally anaphylactic shock, myocarditis, and hepatitis.

It is widely believed that Loeffler's syndrome is a manifestation of antigen antibody reaction in pulmonary tissues. In cases that have come to autopsy, changes in the blood vessels and in collagen have been suggestive of those produced by experimental sensiti-

zation. Furthermore, the tendency for Loeffler's syndrome to occur more frequently in patients with asthma is suggestive of an allergic basis for the lesions. In most cases, no obvious allergen can be implicated. In others, however, a variety of antigenic substances has been suspected, including plant pollens and different bacteria and parasites. It is possible that the syndrome follows a variable course, dependent upon the reactivity of the host and the nature of the allergen.

Five roentgenograms; 1 table.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

**Transient Undiagnosed Intrathoracic Lymphadenopathy in Apparently Healthy Persons.** Aaron D. Chaves and Hans Abeles. Am. Rev. Tuberc. **67:** 45–58, January 1953.

Twenty cases of intrathoracic adenopathy are reported, all in persons who had no symptoms. The lymph node enlargement was found on routine chest films and on survey films. Hilar involvement was present in all cases (unilateral in 2). Paratracheal nodes were enlarged in 10 cases. In no instance was a definite diagnosis established. All of the involved nodes disappeared spontaneously, and no symptoms or recurrences were noted during a mean observation period of five years. Since all of the subjects were asymptomatic and were not inclined to submit to extensive examination, diagnostic studies were limited to chest roentgenograms, tuberculin testing, and physical examinations, along with routine laboratory work in some instances. Six of the patients had peripheral adenopathy, but did not permit biopsy. In 11 patients who could be followed at frequent intervals, complete disappearance of the node enlargement occurred within two and one-half to nine months.

Since intrathoracic adenopathy is noted in diseases such as sarcoidosis, tuberculosis, the lymphomata, some of the mycoses, bronchogenic carcinoma, and others, it is necessary to conduct the most intensive investigation possible to make a definite diagnosis. Frequently, however, this is not established. Although some of the patients probably have an apparently benign enlargement of mediastinal nodes such as was found in the present study, the authors feel that thoracotomy should be done at once in patients with unilateral hilar involvement and should be considered in the case of bilateral involvement when other methods fail to elicit a definite diagnosis. They do not advise radiation therapy as a "diagnostic test."

Sixteen roentgenograms; 1 table.

JOHN H. JUHL, M.D.
Minneapolis, Minn.

**Diagnosis of Intrathoracic Goitre.** G. Ansell. J. Fac. Radiologists **4:** 197–206, January 1953.

The term "intrathoracic goiter" implies that some portion of the thyroid remains permanently within the thoracic cage. The diagnosis may be suspected when a routine chest film reveals the presence of a superior mediastinal tumor.

Radiographically, the goiter shows as a fairly smooth, rounded shadow down through the thoracic inlet in front of or to one or other side of the trachea. Occasionally, thyroid tissue may present on both sides of the trachea. Less commonly, the goiter is situated in the posterior mediastinum.

The aortic knuckle is often depressed by intrathoracic goiter, and there is usually a distinct angle between the goiter and the aortic shadow, whereas in aneurysms of the aorta, the mass usually merges with the aorta. The goiter usually rises with deglutition, producing a change in the angle between it and the aortic shadow.

Since radioactive iodine is known to concentrate in functioning thyroid tissue, 15 patients with suspected intrathoracic goiter were given tracer doses of the isotope. The final diagnoses were: intrathoracic goiter, 8 cases; deep goiter, 5 cases; bronchogenic cyst, 1 case; reticulosis of mediastinal nodes, 1 case. Radioactive iodine was found to be of help in differentiating intrathoracic goiters from other mediastinal lesions. It is pointed out, however, that failure to demonstrate iodine-concentrating tissue in the chest, while it makes a diagnosis of intrathoracic goiter less likely, does not entirely exclude it. Those intrathoracic goiters which do not collect radioactive iodine are likely to be the site of extensive necrosis, or of cystic or malignant change.

Seven roentgenograms; 6 photographs.

I. R. BERGER, M.D.
Atlanta, Ga.

**Pneumomediastinum and Pneumothorax Following Block Dissection of the Neck.** David Aiken and Herbert F. Smith. Brit. J. Surg. **40:** 325–331, January 1953.

The authors report 6 cases of pneumothorax and 2 cases of pneumomediastinum occurring after block dissection of the neck. Four of these patients died and the postmortem findings are discussed in detail.

Mediastinal emphysema, subcutaneous emphysema, and pneumothorax are well recognized complications of lower neck surgery. Three possible routes by which the air reaches the tissues have been mentioned in the literature: injury to the mucosa of the upper respiratory tract (associated with endotracheal anesthesia); injury to the apical pleura during surgery; and rupture of marginal alveoli with passage of the air along the vascular sheaths to the hilus. The authors suggest a fourth mechanism, which they consider most likely. They feel that the air enters the mediastinum along the course of the carotid sheath. In support of this, they point out the fact that the carotid sheath is the only fascial plane which leads directly from the operative site into the superior mediastinum. In 6 of the 8 cases, a sucking sound was heard at the inner end of the supraclavicular fossa. An x-ray film of 1 of the cases is reproduced, showing an air channel extending along the carotid vessels from the site of the block dissection to the superior mediastinum.

Since this complication appeared only 8 times in 900 similar block dissections of the neck, some other factor than an open carotid sheath is probably also involved. The authors believe this to be respiratory obstruction for, if the respiratory passages are unobstructed, it would appear that the normal negative mediastinal pressure is not sufficient to draw air along the carotid sheath.

The important points in diagnosis, prevention, and treatment of postoperative pneumothorax and pneumomediastinum are discussed briefly.

Four roentgenograms.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

**Hemangioma of the Mediastinum. Case Report.** James M. Keegan. Am. J. Roentgenol. **69:** 66–68, January 1953.

In a review of the literature, the author found reports of only 18 mediastinal tumors of vascular origin, 7 of which were hemangiomata. His patient was an 18-year-old white female with non-radiating epigastric pain associated with anorexia, vomiting, and a slight weight loss. Roentgenographic studies revealed a non-pulsating mass in the anterior mediastinum, extending into the right hilar area. This mass measured about 8.5 × 7 cm., and just below it was a separate smaller mass. Angiocardiography, performed elsewhere, revealed a pressure defect on the superior vena cava, which was displaced posteriorly. Thoracotomy disclosed a cystic mass which appeared to invade the right side of the heart, with extension into the left hilar and subdiaphragmatic areas. The lesion was regarded as inoperable and the chest was closed after biopsy. The pathologic study revealed a rather typical hemangioma, histopathologically benign but with gross and microscopic evidence of invasiveness. Seven months after the surgery, the patient remained asymptomatic. Radiation therapy had no significant effect upon the size of the lesion.

Five roentgenograms. JOE B. SCRUGGS, M.D.
University of Arkansas

**Problems in Roentgen Ray Diagnosis of Congenital Heart Conditions.** E. W. Spackman. Texas State J. Med. **49:** 5–12, January 1953.

In outline form the author presents the many problems encountered in the diagnosis of congenital heart disease radiographically. He first points out some of the pitfalls in the various special procedures and then briefly discusses the more common types of malformation. Routine and special procedures and their findings (or lack of findings) are presented for each condition, always correlated with the clinical picture.

Such a presentation is not adapted to abstracting, since it is itself essentially a condensation, but the original article can be recommended as a summary of this field.

Ten tables. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

**Postmortem X-Ray Studies of Congenital Malformations of the Heart.** Ruby M. Collister, J. Dankmeijer, H. A. Snellen, and W. H. van der Wel. Arch. Path. **55:** 31–46, January 1953.

The authors present a new method for investigating congenital cardiac malformations postmortem which involves a succession of injections into the heart and great vessels of a suspension of barium sulfate in water. A roentgenogram is taken after each injection. The aim is always to make an exact diagnosis of the malformation before any fixation or anatomical preparation of the specimen is undertaken.

The routine plan of injections is subject to alteration in the individual case, particularly when there have been no exact clinical investigation and diagnosis. In such cases, after the results of each injection have been studied on the subsequent film, the procedure is modified appropriately.

Eight cases are reported, each of which demonstrates one or more salient points in the use of the method and its results, while some of the difficulties encountered in the interpretation of the films are also brought forward. Included are a typical case of tetralogy of Fallot; a case of pulmonary stenosis and patent foramen ovale; one of cor triloculare biatriatum with stenosis of the pulmonary artery; a case of transposition of the great vessels; a case in which the pulmonary artery was abnormally wide and the ductus arteriosus patent; an instance of atresia of the pulmonary artery with a single ventricle; a case of extreme stenosis of the aorta with a rudimentary left ventricle and a widely patent ductus arteriosus, which functionally was a truncus arteriosus; and a case of tricuspid valve atresia with an atrium commune and a ventricular septum defect, in which both auricles lay on the left side of the main arterial trunks.

Twenty-seven roentgenograms with accompanying drawings.

**Changes in the Heart Silhouette as Studied by Angiocardiography.** Christian Hedman, John Lind, and Carl Wegelius. J. Fac. Radiologists **4:** 190–192, January 1953.

Previous investigations concerning whether or not the left auricular appendage does form a part of the left cardiac silhouette in the frontal position have to a great extent depended upon the comparison of radiographs with autopsy findings. The present study was based on angiocardiographic evidence obtained from studies done on 5 normal children aged between eighteen days and five years. This leads the authors to believe that the phase of cardiac cycle determines whether or not the left auricular appendage will form a part of the left cardiac border. Each angiocardiogram in their study was synchronized with the phase of the cycle by means of electrocardiography, and they came to the conclusion that the left auricular appendage is marginal during auricular diastole, but not during auricular systole.

A similar study was made in a case of left auricular dilatation associated with incomplete emptying due to mitral stenosis. The films showed that there was no measurable difference in the size of the auricles in systole and diastole, and in both phases of the cardiac cycle the left auricular appendage was marginal.

Four angiocardiograms. C. R. JONES, M.D.
Atlanta, Ga.

**The Electrocardiogram During Angiocardiography.** Geoffrey Reynolds. Brit. Heart J. **15:** 74–82, January 1953.

To ascertain, if possible, the cause of occasional deaths in association with angiocardiography, especially in children with cyanotic congenital heart disease, the author studied a series of patients by electrocardiograms obtained before, during, and at intervals after injection of the contrast medium (Diodone). The technic of the investigation has been described elsewhere (Carnegie: Brit. M. J. **1:** 1230, 1951. Abst. in Radiology **58:** 766, 1952).

This paper analyzes the first 75 consecutive electrocardiograms taken on 73 patients, 1 of whom died. Seventy-two of the series had congenital heart lesions, the majority tetralogy of Fallot. All but 4 were cyanosed. The age range was from three to thirty-five years.

In 60 per cent of the cases studied some significant abnormality was found. This was due in some in-

stances to the anesthetic, in some to the contrast medium, and in some it had no apparent relation to either.

Abnormal rhythms occurred in about 25 per cent of the patients. They usually appeared to be due to the anesthetic, and in some instances were terminated by the injection. Auricular flutter and fibrillation were not seen, but both flutter and fibrillation of the ventricle were present in the 1 fatal case.

Twenty-five per cent of the patients had some type of conduction defect, in most instances apparently attributable to the medium.

S-T segment deviation was encountered in nearly one-third of the series. The Diodone was held responsible for this change in most cases, though in some another factor—not necessarily the anesthetic—must have played a part. Changes in the T and P waves were insignificant. Q-T interval measurements were not possible often enough to be of value.

Six cases in which there was anxiety over the outcome are reported. Four of these were from the series of 75, including the 1 fatality. Two cases, both fatal, were from a later study. The early changes in the patients whose clinical condition gave rise to anxiety were mainly those of a depressed conduction and to a lesser extent of S-T deviation. The initial change in all 3 fatal cases was the appearance of an ectopic pacemaker, although in 1 it was accompanied by abnormalities that were more certainly pathological and in 2 it disappeared before more serious disturbances occurred.

The author concludes that electrocardiography should be done during angiocardiography. If S-T deviation or conduction defects are found, the procedure should be abandoned unless these are due to anoxia which can be rectified immediately. He was not able to determine if the lesion which brings on the general collapse in fatalities is in the lung, heart, brain, or peripheral tissues.

Five electrocardiograms; 2 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

**The Appearance of the Internal Mammary Arteries in Coarctation of the Aorta.** Per Ödman. Acta radiol. **39**: 47–56, January 1953.

In the majority of cases of coarctation of the aorta it is possible to see the dilated internal mammary arteries on conventional lateral chest films. They are apparent close to the bony anterior chest wall as a soft-tissue band of varying width, in sharp contrast to the adjacent lung. Double contours, representing two vessels, are sometimes observed. The band narrows as it passes downward. Small localized soft-tissue shadows are produced by localized tortuosities of the dilated arteries. It is possible to note vessel pulsations fluoroscopically and to record these electrokymographically. On occasion a depressed sternum may obscure visualization of the vessels.

For demonstration of the dilated arteries, the author uses high-voltage (110 kv.) technic, with long distance and short exposure time. The changes may be observed in the absence of rib scalloping or other changes. This is especially important in children.

The roentgen study of the dilated internal mammary arteries is of importance not only for the diagnosis of coarctation of the aorta but also for assessment of the collateral circulation. Postoperatively it enables long-term repeated follow-up studies to be carried out much more simply than by thoracic aortography. Following successful surgery the dilated collaterals gradually decrease in size, becoming invisible in about two years. Failure to regress suggests a poor prognosis, often due to residual stenosis at the anastomosis site.

Twenty-one roentgenograms.

PAUL MASSIK, M.D.
Quincy, Mass.

**Studies in Mitral Stenosis: IV. The Relative Merits of Various Diagnostic Methods in Mitral Valvular Disease.** G. Biörck, O. Axén, H. Krook, L. Andrén, and H. B. Wulff. Am. Heart J. **45**: 13–39, January 1953.

For the proper selection of patients with mitral valvular disease for operation, it is not only fundamental to make a correct diagnosis of the lesion *per se*, but it is essential to estimate the relative importance of the stenotic and regurgitant components. Operation for mitral stenosis is a routine procedure, while surgery for regurgitation is still in a somewhat experimental stage.

A differentiation between predominant stenosis and predominant regurgitation must be made on the basis of their effects upon the cardiopulmonary hemodynamics. In pure mitral stenosis there is an enlarged left auricle, with no enlargement of the ventricle, typical stenotic murmurs, a pathologic increase in left auricular and pulmonary venous pressures during auricular systole, and a delayed flow in the lesser circulation. In mitral regurgitation, there are enlargement of the left auricle and left ventricle, a systolic murmur, a systolic pressure wave in the auricle and pulmonary veins during ventricular systole, and the blood flow in the lesser circulation is not necessarily slowed. The main points of differentiation should be the left ventricular size, the murmurs at the mitral orifice, pressure and volume changes within the left auricle and the pulmonary veins, and the type of blood passage through the pulmonary circulation and the left heart.

The authors studied 25 cases, using palpation, percussion, standard and unipolar chest lead electrocardiography, roentgenography, and angiocardiography, to determine left ventricular size. To evaluate murmurs, they used palpation, auscultation, and phonocardiography. Pressure and volume changes in the left auricle and pulmonary veins were determined by electrokymography and cardiac catheterization. Determination of circulation time and angiocardiography were employed for assessment of the rate of blood flow through the lesser circulation. It was also believed that ballistocardiography might give some information on the type of cardiac output.

The material studied included 2 cases of mitral regurgitation proved at operation, 3 cases of clinically probable mitral regurgitation, and 7 cases of mitral stenosis with noteworthy mitral regurgitation indicated by one or more methods. In 5 of the last group, operation failed to confirm regurgitation, while in 1 some regurgitation was found. No surgery was performed in the 7th case.

In order of usefulness for discrimination between preponderant mitral stenosis and regurgitation, the methods employed were found to rank as follows: (1) auscultation; (2) roentgenography; (3) angiocardiography and electrokymography; (4) the unipolar chest lead electrocardiogram; (5) apex beat; (6) axis

deviation; (7) pulmonary capillary venous tracings at cardiac catheterization.

With conventional roentgenography, the shape of the left auricle is usually easy to ascertain, while delimitation of the left ventricle is sometimes difficult. In this respect, as well as for the study of cardiac hemodynamics, angiocardiography was found to be very helpful. Kymography is illuminating, but its usefulness is limited.

Six figures, including 2 roentgenograms; 4 tables.

HENRY K. TAYLOR, M.D.
New York, N. Y.

**Mitral Incompetence.** Wallace Brigden and Aubrey Leatham. Brit. Heart J. **15:** 55–73, January 1953.

The closer study being given to valvular heart disease since heart surgery has made its recent advances is yielding many dividends, of which this article is a good example. For some time past it has been taught that mitral regurgitation without stenosis is very rare and practically impossible to diagnose.

Thirty cases of what the authors believe to be mitral incompetence due to endocarditis are reviewed, including historical and clinical data, phono- and electrocardiograms, roentgen findings, and autopsy summaries in 9.

The significant finding by either fluoroscopy or roentgenkymography was obvious systolic expansion of the left auricle. This may be seen in both the anterior and oblique views. Failure to demonstrate this phenomenon does not, however, rule out the diagnosis, since it may be masked by excessive enlargement or clot formation.

Clinically there were some factors which cast doubt on the relationship of pure mitral regurgitation to rheumatic fever. Patients were predominantly of the male sex; the average age of the group was greater than for other valve lesions (except "pure" aortic stenosis, which shares most of the other differences); a history of rheumatic fever was rare; heart failure was quite late in onset and unresponsive to treatment, and there was a relative frequency of bacterial endocarditis.

Many patients showed frequent extrasystoles which were symptomatic ("palpitation"). Left ventricular enlargement was the rule, as was a systolic murmur. One patient showed a faint diastolic murmur although at autopsy there was no stenosis.

Anyone evaluating cases for cardiac surgery should read this article in the original.

Six roentgenograms; 2 electrocardiograms; 9 phonocardiograms; 3 photographs; 2 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

**Rheumatic Pericarditis.** G. T. Thomas, E. M. M. Besterman, and A. Hollman. Brit. Heart J. **15:** 29–36, January 1953.

The subject of rheumatic pericarditis is infrequently discussed in the literature and some of the opinions found are conflicting. The authors have analyzed a series of 30 cases with effusion and 8 without.

One important fact brought out was that "dry" pericarditis was invariably an early manifestation of a mild rheumatic infection, had no influence on the prognosis, and was not accompanied by severe clinical signs. Four of the "dry" cases showed residual valve lesions but all the patients survived.

Patients with effusion usually gave a long rheumatic history and showed signs of a severe infection. Fifteen of the 30 died, and only 1 escaped without a valve lesion.

X-ray evidence of pericardial effusion was frequently preceded by increase in venous pressure or abnormal signs at the lung bases (usually due to associated pleural effusions).

In "dry" pericarditis the electrocardiograms were normal but elevation of the S-T segment was frequently found in the cases with effusion. Only 6 with effusion had normal curves: 4 of these had had digitalis, which could have masked the changes, and the other 2 were not examined as often as the rest of the group.

Six roentgenograms; 6 electrocardiograms; 2 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Michigan

**Ebstein's Anomaly of the Tricuspid Valve.** J. F. Goodwin, Allan Wynn, and R. E. Steiner. Am. Heart J. **45:** 144–158, January 1953.

Ebstein's anomaly consists of a fusion of the leaflets of the tricuspid valve into a membrane which extends downward "like a sheet or basket" into the right ventricle, dividing it into two portions, a proximal auricular portion and a distal ventricular portion. The communication between the two portions lies either between the free margin of the valve and the ventricular septum or consists of an opening in the valve leaflet itself. The foramen ovale may be functionally patent, or there may be an atrioseptal defect. The malformation results in great dilatation of the right auricle, impairment of action of the right ventricle, and a consequent decrease in pulmonary artery blood flow and underfilling of the lungs.

The authors present the case of a 14-year-old boy in whom a diagnosis of Ebstein's anomaly was made clinically and verified postmortem. Two additional cases are described. In one, the clinical criteria were held to warrant a presumptive diagnosis of Ebstein's anomaly; in the second pulmonary stenosis, with a normal aortic root and a right-to-left interauricular shunt, led to fluoroscopic and angiocardiographic findings suggestive of Ebstein's syndrome.

Ebstein's anomaly is most likely to be confused with (1) pulmonary stenosis with a normal aortic root and an interauricular defect with a right-to-left shunt, (2) tricuspid atresia, and (3) tetralogy of Fallot.

In the extreme form of the anomaly the radiographic signs are a very large globular heart shadow with great enlargement of the right auricle, feeble pulsation over the right ventricle, poorly visualized pulmonary arteries, and anemic lungs.

Six roentgenograms; 4 drawings; 3 electrocardiograms; 2 phonocardiograms; 1 table.

HENRY K. TAYLOR, M.D.
New York, N. Y.

**Asymptomatic Isolated Valvular Pulmonary Stenosis. Diagnosis by Clinical Methods.** S. Gilbert Blount, Jr., Seiichi Komesu, and Malcolm C. McCord. New England J. Med. **248:** 5–11, Jan. 1, 1953.

Before the days of cardiac surgery a non-cyanotic patient with a loud systolic murmur, good general health without limitation of activity, and no rheumatic history was considered to have a ventricular septal defect or *maladie de Roger;* isolated pulmonary stenosis was not even considered as a diagnosis, since this was

thought to cause severe disability and cyanosis. The use of the cardiac catheter has shown that such a patient is actually far more likely to have an asymptomatic stenosis of the pulmonary valve. Within a period of eighteen months, the authors observed 21 cases, all of which were diagnosed clinically.

Many patients with pulmonary stenosis have high systolic pressures in the right ventricle and will eventually die of cardiac failure if not relieved by valvulotomy. A pressure of 75 mm. is now taken as indication for the operation.

In making the diagnosis a number of points are to be kept in mind: (1) There may be slight or no limitation of activity. (2) Development may be normal. (3) Cyanosis is absent. (4) There are usually a harsh systolic murmur and a thrill. (5) The electrocardiogram is normal or shows right ventricular hypertrophy. (6) Fluoroscopic observations are of great importance. The lung fields may show a normal or diminished vascular pattern; the pulmonary artery is increased in size (post-stenotic dilatation), with increased pulsation of the main trunk but decreased pulsation in the right and left branches; the overall cardiac size is usually normal but there may be evidence of right ventricular hypertrophy.

Six illustrative case reports are given.

Three roentgenograms; 1 electrocardiogram; 2 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

**Traumatic Rupture of the Thoracic Aorta. A Case Report.** William H. Kastl. Ann. Surg. **137:** 111–114, January 1953.

On rupture of the thoracic aorta, death usually follows so closely that an autopsy diagnosis is the rule. One case has been described with survival for twenty days (Rice and Wittstruck, J.A.M.A. **147:** 915, 1951). The author's patient lived ten days, though the true diagnosis was not made antemortem.

Sudden severe deceleration of the body associated with increase in intra-aortic pressure is probably a significant factor in the production of rupture of the aorta. During horizontal deceleration of the thorax the mobile portion of the aorta is slowed at a different rate than the arch, which is relatively fixed. The aorta with its column of blood is thereby thrown forward, exerting a maximum pull at the isthmus, where the rupture usually occurs. Death usually ensues from hemorrhage into the mediastinal tissues and into one or both pleural cavities.

The author's patient had been in an automobile collision. He was asleep at the time and remained unconscious twelve hours following the trauma. He then complained of headache, substernal pain on respiration, and pain in the right leg. Physical examination showed evidence of a hydrothorax on the left. The extremities were of normal warmth. No note was made of the presence or absence of peripheral pulsations. No fractures were discovered radiographically, but there was fluid in the left pleural cavity, with only a small amount of aerated lung.

Thoracentesis yielded a liter of serosanguineous fluid. Repeated radiographs showed persistent fluid in the left base and some shift of the heart to the left. There was widening of the upper mediastinal shadow to the left, interpreted as possible atelectasis of the left upper lobe.

On the tenth day after trauma, bronchoscopy was done because of the possible atelectasis. A moderate amount of thick mucus was removed from the left bronchus, which was deviated somewhat to the left. Nine hours later, the patient went into shock and died in a short time. Autopsy showed complete transection of the aorta just distal to the left subclavian artery. About the site of the rupture was a large organized clot. Microscopic section of the aorta showed hydropic degeneration of the media, thought to have predisposed to the traumatic rupture.

In retrospect the author believes that the diagnosis should have been suspected in view of the evidence of mediastinal widening on the roentgenograms and the occurrence of hemothorax without rib fracture.

Two roentgenograms.

BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

## THE DIGESTIVE SYSTEM

**The Inferior Esophageal Constrictor in Relation to Lower Esophageal Disease.** Earle B. Kay. J. Thoracic Surg. **25:** 1–13, January 1953.

The outer muscle layer of the esophagus extends from the cricoid cartilage and cricopharyngeus muscle to the middle and outer layers of the cardia. The inner muscular layers are less well developed. Their fibers are arranged differently in different segments of the esophagus. They run elliptically around the esophagus and downward in the upper third; they are circular for a small segment in the middle third; they again have an elliptical course in a downward direction below the middle third, winding about the esophagus in a spiral manner. About 1 to 3 cm. above the diaphragmatic hiatus is a circumscribed thickening of the inner muscular layer which has been called the lower physiologic constrictor or inferior esophageal sphincter. Longitudinal fibers of this sphincter insert into the longitudinal layer and have a dilating action on the sphincter. Section of the inner muscle layer demonstrates areas where the thickness is considerably less than elsewhere. These weak points are factors in the development of pulsion diverticula. Diverticula have in their walls fibers from the outer longitudinal muscle but not from the inner layer, which further suggests herniation through a weak point in the inner muscle.

A preponderance of sympathetic control of the muscular coordination of the esophagus might occur when there is degeneration or absence of the ganglion cells of Auerbach's plexus. This would make muscular coordination impossible, causing contraction and hypertrophy of the inferior esophageal constrictor, with a resulting esophageal obstruction.

The inferior esophageal constrictor is best demonstrated in its hypertrophied state and mega-esophagus. In these conditions, stimulation of the vagus may cause a relaxation of the sphincter in the milder cases. The sphincter-like action may be demonstrated by dilatation under the influence of amyl nitrite and ergotamine. Hypertrophy of the muscular constrictor or sphincter was found in 15 patients with achalasia operated upon by the author. The symptoms of achalasia can be relieved by transecting the inferior esophageal constrictor, which suggests that this muscular band is a predominant factor in the development of the condition.

The author believes that functional dysphagia, esophagospasm, and the Plummer-Vinson syndrome

may be minor manifestations of esophageal dysfunction caused by sympathetic imbalance in muscular coordination associated with hypertrophy of the inferior esophageal constrictor.

Patients with pulsion diverticula frequently show a temporary delay of barium in the terminal esophagus at the site of the inferior esophageal constrictor. Some have a moderately severe cardiospasm and tortuosity of the esophagus. The symptoms often can be relieved by dilating the esophagus. This suggests that hypertrophy of the inferior esophageal constrictor causes an esophageal obstruction which, through the resultant increase in intraesophageal pressure, causes the mucous membrane to herniate through weak areas of the inner muscle layer.

In patients with a relaxed inferior esophageal constrictor associated with a relaxed diaphragmatico-esophageal ligament, hiatus hernias may develop. The diaphragmatico-esophageal ligament is the antagonist of the longitudinal muscle of the esophagus and prevents the esophagus from pulling the stomach into the chest during swallowing. Relaxation of the ligament allows the stomach to herniate into the posterior mediastinum and the relaxed constrictor allows regurgitation of gastric juice, with resulting esophagitis. Persistent esophagitis may cause secondary scarring and stricture formation, leading to permanent shortening of the esophagus.

Idiopathic stricture of the terminal esophagus may occur without evidence of hiatal hernia or short esophagus. This may be the result of a faulty closing mechanism in the terminal esophagus, with resulting regurgitation of the gastric juice, resulting in esophagitis and stricture.

Patients are also seen who have difficulty in swallowing without pre-existing esophageal or gastric complaints. It is possible that in these patients organic stricture may be secondary to esophagitis resulting from functional obstruction of the inferior esophageal constrictor. Relief is usually afforded by medical management, including ulcer diet and esophageal dilatation.

The author concludes that either spasm or hypertrophy of the inferior esophageal constrictor may cause functional stenosis and may be a factor in producing dysphagia, Plummer-Vinson's syndrome, esophagospasm, achalasia, pulsion diverticula of the thoracic esophagus, and idiopathic strictures of the terminal esophagus. There is evidence to suggest that the spasm and hypertrophy result from a preponderance of sympathetic control.

Twelve roentgenograms; 6 photographs; 1 photomicrograph.

R. G. FORTIER, M.D.
St. Paul, Minn.

**Peptic Oesophagitis and Ulceration.** Eric Samuel. South African M. J. **26:** 1010–1013, Dec. 20, 1952.

Hiatus hernia, pregnancy, and the presence of an indwelling stomach tube are associated with peptic esophagitis because these conditions allow reflux of gastric juice into the esophagus. The acid digestion of the esophageal mucosa is the initial feature of the esophagitis. However, there are many cases of peptic esophagitis is which there is no anatomical derangement. Although some of these may show a physiological insufficiency of the cardiac sphincter at fluoroscopy, it is also true that in many instances in which a reflux of barium into the esophagus can be shown, there are no symptoms. Other factors, therefore, beside hiatal insufficiency probably contribute to the etiology of esophagitis.

The radiological features of esophagitis without ulceration are not specific. Aside from cardio-esophageal reflux, they consist of spasm of the esophagus and irregularity of the mucosal contour. The spasm may take the form of tertiary spasm, longitudinal narrowing, or circular spasm. Longitudinal narrowing is diffuse and is probably the result of a diffuse spasm of the circular muscles of the esophagus. Circular spasm is less common and appears as a localized narrowing, usually near a crater.

Demonstration of the crater or niche is the only conclusive evidence of peptic ulceration. This is usually small and seldom deeply penetrating. Since it is frequently found in association with hiatus hernia, it should be carefully sought when hiatus hernia is demonstrated.

Eight cases of peptic esophagitis and peptic ulceration are reported. Conditions to be differentiated are chemical esophagitis, strictures, and carcinoma.

Eight roentgenograms.

DAVID D. ROSENFELD, M.D.
Fontana, Calif.

**Transdiaphragmatic Duplication of the Alimentary Tract.** John J. Snodgrass. Am. J. Roentgenol. **69:** 42–53, January 1953.

In a review of the literature, the author found only 5 cases of duplication of the alimentary tract penetrating the diaphragm and communicating with the small intestine. A sixth case is presented. The patient was a white female five and a half years old with a large alimentary duplication penetrating the right crus of the diaphragm and communicating with the jejunum. In addition, this patient had a malrotation of the mid-gut.

The roentgenographic picture was that of a small intestinal obstruction. A chest film revealed a large, abnormal, smooth shadow in the medial portion of the right chest. The center of this density was translucent and extended from the superior thoracic inlet to the diaphragm. Numerous skeletal anomalies were also noted. At operation, an intestinal obstruction was found in addition to a dilatation of the esophageal hiatus, but no actual herniation could be seen.

The day following operation, roentgen examination again revealed the abnormal density in the right chest. Some days later, an upper gastrointestinal study was done. In about fifteen minutes, flecks of barium could be seen going upward along the right paraspinal area to a collection of barium above the diaphragm in the region of the abnormal density previously observed. It was felt that this confirmed the suspected diagnosis of a communicating alimentary duplication with the thoracic component penetrating the right leaf of the diaphragm. Re-exploration of the abdomen and exploration of the mediastinum by surgery showed the diagnosis to be correct.

A complete and detailed discussion of this anomaly is presented, along with an extensive review of the literature and a comprehensive bibliography. Several theories as to the pathogenesis are presented. The author favors the vacuole persistence theory as best explaining the wide variety of duplications seen. In the embryonic development of the fetus, epithelial proliferation of the lining of the primitive gut obliterates the lumen at about six weeks. Coalescence of vacuoles, which appears soon after the obliteration, re-

establishes the patency of the gut. Failure of complete coalescence, which can occur at any level, results in atresia or lateral isolation of clusters of these vacuoles, and this may result in duplication.

From the roentgenographic standpoint, the predominance of right-sided posterior lesions is outstanding. They may be small and partially obscured both in the postero-anterior and lateral projections, and the author recommends that oblique films and heavily penetrated Bucky films of the chest should be used to help outline the lesion. Studies of the esophagus frequently show a change in its position or may actually show a communication with a duplication. Skeletal anomalies and changes in the abdominal intestinal tract as evidenced by barium studies should lead one to view the abnormal chest finding with suspicion. The small intestinal enema is felt to have a definite advantage in study of the suspected communication.

Surgical removal of the duplicated portion of the gut is mandatory, to relieve symptoms and avoid the possible complication of hemorrhage and ulceration.

Eight roentgenograms; 4 photographs; 1 drawing.

JOE B. SCRUGGS, M.D.
University of Arkansas

**Diagnostic Accuracy of Gastroscopy in Neoplasms of the Stomach.** Lester Baker, Edmund A. Gorvett, and Mitchell A. Spellberg. Cancer **5**: 1116–1127, November 1952.

In the diagnosis of carcinoma of the stomach, the two procedures on which most diagnostic reliance is placed are gastroscopy and gastrointestinal roentgenographic examination. In this paper, the authors attempt to show the comparative value of these procedures. All of the histologically proved cases of gastric neoplasm seen at the Veterans Administration Hospital at Hines, Ill., in the period of 1946–50, were studied. In all, one or more gastroscopic examinations as well as roentgen examinations had been done. The reports of the examinations were reviewed and classified as either correct or incorrect. In cases where gastroscopic examination was not performed because of technical reasons or arrest of the instrument at the cardia, the diagnosis was considered incorrect.

One hunded and six cases were studied, including 100 of gastric carcinoma, 3 of primary lymphosarcoma, 1 of Hodgkin's disease of the stomach, and 2 of gastric leiomyosarcoma. On the initial roentgenographic examination, 61 of the 106 cases (58 per cent) were correctly diagnosed. A repeat examination in 23 of the 45 cases incorrectly diagnosed initially led to a correct diagnosis in 11 more. Thus, 72 of the 106 cases (68 per cent) were correctly diagnosed by radiologic means. With gastroscopy, the diagnosis was correctly made on the initial examination in 75 cases (70 per cent); of the remaining incorrectly diagnosed cases, only 4 were resubmitted to gastroscopy, and the diagnosis was correctly revised in 2. The overall number of correctly diagnosed cases by gastroscopy was thus 73 per cent. When both procedures were employed, only 9 cases (8 per cent) were incorrectly diagnosed.

When the accuracy of diagnosis was checked against the anatomical appearance of the tumor, it was found that 80 per cent of polypoid tumors were correctly diagnosed by roentgenologic means, while only 38 per cent of the ulcerative lesions were accurately diagnosed. Of diffuse lesions, 43 per cent were correctly diagnosed radiologically. Gastroscopy was most accurate in the diffuse lesions, of which 86 per cent were correctly diagnosed by this means.

In addition to the cases of gastric cancer, this paper includes cases in which suspicion of the neoplasm was aroused at the gastroscopic examination, but in which no neoplasm was subsequently shown to exist. The ratio of false positive diagnoses to verified positive diagnoses by gastroscopy was 1 to 3.

The roentgenologic examinations in this series were performed by at least twenty different examiners, the majority of whom were residents in radiology. The gastroscopic examinations, on the other hand, were all made by or directly under the supervision of two of the authors.

Six roentgenograms; 2 photographs; 6 tables.

D. S. CHILDS, JR., M.D.
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**Benign Tumours of the Stomach.** R. I. Roberts. Brit. J. Radiol. **26**: 3–12, January 1953.

Benign tumors of the stomach may or may not give symptoms. They are more frequently found at autopsy than they are diagnosed during life. They may be classified as non-epithelial and epithelial. Non-epithelial tumors usually encroach on the lumen of the stomach and may present ulceration. Epithelial benign tumors are usually small and are often multiple.

The roentgen signs that indicate a benign lesion are: smooth rounded appearance, a sharp junction with the gastric wall, possible ulceration at the apex of the tumor, mobility and a surrounding intact mucosa.

Conditions which tend to cause benign tumors to produce symptoms are: proximity to the cardiac or pyloric orifice, torsion of the pedicle, ulceration with consequent hemorrhage, infection, malignant change, and neuromuscular disturbances.

Five illustrative cases are presented.

Twenty-two illustrations, including 7 roentgenograms.

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**Volvulus of the Stomach. Report of a Case.** David L. Jenkinson and L. C. Bate. Am. J. Roentgenol. **69**: 54–58, January 1953.

A mere high position of the stomach with rotation of the entire viscus or an exaggerated form of the transverse steer-horn type of stomach, which may also show various degrees of a cascade effect, should not be confused with volvulus. The term volvulus implies an actual twisting of a portion of the intestine or other viscus, and a diagnosis of volvulus of the stomach should be made only when a definite spiral pattern of the rugae can be demonstrated. Secondary pathological changes which occur consist of various degrees of dilatation of the stomach due to obstruction at the point of torsion, circulatory changes, and edema. Occasionally, the gastrocolic omentum is drawn superiorly by the volvulus, which in turn causes the transverse colon or splenic flexure to be pulled upward.

The conditions most commonly found in association with volvulus of the stomach are elongated gastrohepatic and gastrocolic omenta, eventration of the diaphragm, and esophageal hiatus hernia. Tumors have also been an associated finding. In the presence of one or more of these conditions it seems likely that the volvulus has occurred as a complication rather than on an idiopathic basis. The most common type of

volvulus, in accordance with Singleton's classification (Radiology **34**: 53, 1940), is the anterior organo-axial type.

The most common roentgenologic findings are: (1) high stomach with a cascade appearance of the cardia; (2) hour-glass configuration of the pars media, with demonstration of a definite spiral appearance of the rugae; (3) location of the greater curvature of the stomach above the lesser curvature; (4) the pyloric portion and duodenal bulb pointing downward and to the right, with a wide low curve of the second and third parts of the duodenum. The most common symptoms are intermittent attacks of colicky abdominal pain, fullness or distention of the upper abdomen, vomiting, complaints suggesting gastric or duodenal ulcer, and loss of weight. In cases showing recurrence of symptoms and findings after aspiration and in acute cases with complete obstruction or gradually increasing distention, surgical management is indicated.

The authors report a case in a 49-year-old female with typical history and characteristic physical and roentgen findings. At surgery there were found a complete organo-axial volvulus and mesenterio-axial rotation of the stomach, both of 180 degrees. Reduction of the volvulus was accomplished and posterior gastroenterostomy was performed. There was a recurrence of the volvulus although the patient's general condition was very much improved.

Three roentgenograms.

I. MESCHAN, M.D.
University of Arkansas

**Meckel's Diverticulum as a Cause of Intussusception.** Brit. B. Gay, Jr., Ted F. Leigh, and James V. Rogers, Jr. J. M. A. Georgia **42**: 15–18, January 1953.

Meckel's diverticulum is an anomaly of the small intestine due to failure of the omphalomesenteric duct to close during fetal development. It consists of an outpouching of the ileum from the antimesenteric border, usually located from 18 to 36 inches from the ileocecal valve. Approximately one-fourth of the patients with this condition have symptoms and complications. The complications may be classified as (1) acute inflammation, (2) perforation, which may follow acute inflammation, (3) hemorrhage, (4) mechanical intestinal obstruction, (5) tumor formation (rare), (6) intussusception following invagination of the diverticulum into the ileal lumen. This last complication occurred in the cases reported here.

The patient was a 31-year-old man with a two-week history of periumbilical pain following a laxative. Watery diarrhea developed three days before admission, followed by tarry stools and some containing red blood. Routine studies of the chest and abdomen and a barium enema study were negative. An upper gastrointestinal examination revealed a filling defect on the three-hour film suggestive of a tumor. At operation, a firm elongated mass 3 feet from the ileocecal valve was found, representing an ileo-ileal intussusception. It could be only partly reduced and a 12-inch segment of ileum was resected. A Meckel's diverticulum was found invaginated into the central portion of the mass.

The second patient was a 20-year-old woman with nausea, vomiting, distention, and intermittent cramping pain occurring on the day following delivery of a normal full-term child. Studies of the abdomen showed gas-distended small intestine with little gas in the colon. The examination was repeated forty-eight hours later and showed increased small bowel distention. At operation, an ileocolic intussusception was found, involving the terminal 14 inches of ileum. At the head of the intussusception was an invaginated Meckel's diverticulum measuring 4 cm. in length.

The mechanism of intussusception is as follows: The diverticular pouch invaginates into the ileum and acts as a polypoid mass which the intestine attempts to propel along the lumen through vigorous peristalsis. The invaginated diverticulum acts in the same manner as other polypoid lesions of the small bowel which produce intussusception. The diverticulum becomes the head of the intussusception and forms the intussusceptum. The distal intestine into which the invagination occurs becomes the intussuscipiens.

Five figures, including 2 roentgenograms.

FRANK T. MORAN, M.D.
Auburn, N. Y.

**Rectography.** Karl Frech. Fortschr. a. d. Geb. d. Röntgenstrahlen **78**: 53–62, January 1953. (In German)

The author has tried to improve the roentgen diagnosis of rectal lesions by demonstrating the mucosal pattern following the use of suppositories of foam-producing substances (Bismuth subgall., Thymol recrist., Hexamethylenetetramine, and Aluminum aceticotartaric) to which barium sulfate has been added. The patient inserts one to three suppositories high in the rectum and is then asked to walk around for about thirty minutes. Films taken forty to ninety minutes following insertion of the suppositories show a continuous coating of the inner wall of the rectum, ampulla, and terminal sigmoid flexure. Roentgenograms are reproduced demonstrating the normal rectal mucosa and the defects and relief changes incident to rectal neoplasms. The procedure is not supposed to supplant other methods of rectal examination, but is offered as an aid to the diagnosis of rectal lesions.

Twenty-two roentgenograms.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

**Barium Study of Gastrointestinal Tract in Determining Cause of Jaundice.** John W. Beeler and Raymond C. Beeler. J.A.M.A. **151**: 268–270, Jan. 24, 1953.

In the small group of patients with jaundice in whom the etiology may not be otherwise established, examination of the gastrointestinal tract may offer valuable information. This is especially true in obstructive jaundice, which is said to constitute one-half to two-thirds of all cases, excluding hemolytic icterus. Approximately one-half of obstructive cases are of benign origin and half are due to malignant neoplasms. Examples of the former are common duct stones and recurrent pancreatitis; the latter include carcinomas of the pancreas, papilla of Vater, duodenum, gallbladder, and common duct.

Carcinoma of the head of the pancreas is accompanied by jaundice in 50 to 90 per cent of cases. Positive roentgen findings have been reported in 42 to 78 per cent of cases. The antral portion of the stomach may show one or more of the following findings on barium examination: localized deformity, ulceration, narrowing, obstruction, or a filling defect. Widening of the duodenal loop is infrequent and present only with advanced disease. In the less common carcinoma of the ampulla of Vater roentgen findings have been re-

ported in 35 to 80 per cent of the cases. They include a small filling defect or mucosal ulceration of the second portion of the duodenum on its inner aspect. Duodenal carcinoma produces jaundice late, with positive roentgen findings in 33 to 94 per cent in variously reported series. It is more important to detect a lesion and its site than to give the exact diagnosis, for the ampullary region may give rise to a number of neoplasms.

The roentgen diagnosis of cholecystenteric fistula, with the demonstration of air or barium in the biliary tree, has a high degree of accuracy. The finding of esophageal varices may point to unsuspected hepatic cirrhosis. The roentgen manifestations of pancreatitis are functional changes in the duodenum and upper jejunum. Edema of the pancreas may enlarge the duodenal loop. Finally, examination of the gastrointestinal tract may reveal primary gastrointestinal tumors whose hepatic metastases may be the cause of the presenting jaundice.

Three roentgenograms.

WALTER M. WHITEHOUSE, M.D.
University of Michigan

**Intestinal Obstruction in Fibrocystic Disease of the Pancreas.** André Bruwer and John R. Hodgson. Am. J. Roentgenol. **69:** 14–21, January 1953.

It is important to establish a relationship between meconium ileus, meconium peritonitis, and fibrocystic disease of the pancreas. Meconium ileus is almost invariably associated with pancreatic achylia, with resulting obstruction of the small bowel due to the putty-like consistency of the meconium. Meconium peritonitis is the result of perforation of the bowel during the last months of intra-uterine life, during birth, or shortly after birth, with extrusion of meconium into the peritoneal cavity. Calcium deposition may occur in the extruded meconium within as short a period as twenty-four hours.

It is impossible to state with certainty the frequency of meconium peritonitis in association with cystic fibrosis of the pancreas. In some 65 reported cases of the latter disease, there has been an associated intestinal obstruction, and most of these are believed to have been cases of true meconium ileus.

Although pancreatic achylia is present in cases of meconium ileus, it need not be the only or actual cause of the putty-like consistency of meconium. Erythroblastosis fetalis has been described as coexisting with meconium ileus in several cases. Another possibility is a neurogenic abnormality. Occasionally biliary achylia has been described in association with meconium ileus. Atresia of a segment of a distal part of the small intestine in patients with meconium ileus has been regarded as a possible secondary effect.

Roentgen characteristics suggestive of meconium ileus are as follows: (1) over-distention of loops of small intestine with air-fluid levels in the erect position, and an intermixture of small gas bubble-like shadows in the tenacious mucilaginous meconium; (2) a narrow contracted colon in association with the above evidence of intestinal obstruction in a newborn child; (3) associated evidence of emphysema of the lungs, in the form of a flattened and depressed diaphragm.

There are three suggestive and two specific roentgen signs of meconium peritonitis. The three suggestive findings are the same as those described for meconium ileus. The specific signs are free air in the peritoneal space in a newborn infant that has not yet passed meconium and various degrees of calcification in the peritoneal space.

In infants having fibrocystic disease of the pancreas, the prognosis of meconium peritonitis is identical to that of meconium ileus. It would appear that if the intestinal obstruction can be relieved by the newer surgical methods, the ultimate outlook will depend upon the severity of the lesions in the lungs, pancreas, and other organs.

The authors report two cases of pathologically proved fibrocystic disease of the pancreas in association with calcification in the abdomen, and with complicating intestinal obstruction.

Two roentgenograms.

I. MESCHAN, M.D.
University of Arkansas

**Bulbar Defects in Pancreatic Neoplasm Resembling Duodenal Ulcer.** Charles Gottlieb, Samuel L. Beranbaum, and Arnold M. Wald. Gastroenterology **23:** 82–91, January 1953.

The diagnosis of carcinoma of the pancreas is often difficult, particularly when symptoms suggest peptic ulcer and roentgenograms reveal duodenal deformity. The authors quote Bockus and others as stating that about 12 to 14 per cent of patients with cancer of the pancreas have ulcer symptoms.

The main changes seen in pancreatic carcinoma, previously summarized by Poppel and others, are mentioned by the authors. They involve both stomach and duodenum and include deformities, intrusional defects, obstruction, narrowing, dilatation, and widening of the duodenal loop, sometimes with fixation when invasion has occurred. Transverse mucosal folds may be flattened on the concave side of the duodenum and the "reverse 3" sign may be present. There may be an increase in the retrogastric space, with forward displacement of the duodenum or stomach. The authors use lateral films in upright and recumbent positions. For measurements of the retrogastric space, they have found the tables prepared by Sheinmel and Mednick of value (Am. J. Roentgenol. **65:** 77, 1951. Abst. in Radiology **57:** 916, 1951).

Three cases of carcinoma of the pancreas are presented in which an original diagnosis of duodenal ulcer was made and a subsequent gastrointestinal series showed evidence of pancreatic cancer. In each instance, because of preoccupation with duodenal deformity, lateral films were omitted at the time of the first examination and a pancreatic lesion was not considered.

In a fourth case with similar roentgen and clinical findings, operation revealed a duodenal ulcer with secondary pancreatitis. Such cases may be impossible to differentiate from carcinoma of the pancreas.

The authors conclude that in duodenal ulcer one must be alert to the possibility of pancreatic neoplasm. A lateral film study of the retrogastric space is emphasized as an aid in early diagnosis.

Eight roentgenograms.

GEORGE A. SHIPMAN, M.D.
New Orleans, La.

**Surgical Contrast Visualization of the Pancreatic Ducts with a Study of Pancreatic External Secretion.** Lucien Leger. Am. J. Digest. Dis. **20:** 8–12, January 1953.

The author describes a technic for catheterization and

visualization of the duct of Wirsung as an aid in the diagnosis of pancreatic disease. After duodenopancreatic dissection, the duodenal papilla is exposed by a vertical duodenotomy performed over the second portion of the duodenum. The duct of Wirsung is catheterized with a 1-mm. polyethylene tube. Absence of bile and a clear drainage indicate the tube is properly placed. Two to 3 c.c. of 70 per cent Diodone is injected under gentle pressure and roentgenograms are obtained by the following technic: The tube of a mobile unit is placed 20 cm. from the abdominal wall with an exposure of 0.3, 0.4, or 0.5 of a second. The catheter is left in place as long as necessary to obtain repeat roentgenograms and to study the chemical nature of the drainage. Temporary jaundice may occur but no other complications have arisen.

Six roentgenograms are reproduced, demonstrating the normal aspect of the duct as well as the patterns of stricture of the duct, chronic pancreatitis, and pancreatic carcinoma.

WINSTON C. HOLMAN, M.D.
Shreveport, La.

**Multiple Liver Abscesses. Report of a Case Successfully Treated and Followed with Cholangiograms.** Genest de L'Arbre. Ann. Surg. **137**: 135–137, January 1953.

A typical case of multiple liver abscesses is described. At operation multiple nodules were found scattered over the liver surface which yielded pus on aspiration. Biopsy established the diagnosis. The gallbladder was thickened and hyperemic and contained stones. The common duct was dilated. The gallbladder was removed and a T-tube placed in the common duct after removal of quantities of "gravel."

The patient improved but continued to show signs of infection despite administration of antibiotics. A cholangiogram three weeks after operation showed residual stones in the common duct and multiple abscess cavities in the liver associated with the visualized hepatic ducts. At a later operation, the residual stones were removed. The patient improved rapidly and a repeat cholangiogram showed obliteration of the small abscess cavities.

Two roentgenograms.

BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

**Roentgenologic Examination of Gallbladder Without Opacification.** Clyde A. Stevenson. J.A.M.A. **151**: 264–265, Jan. 24, 1953.

The significant findings on the scout film of the gallbladder area are as follows: (1) primary shadow of the gallbladder enlarged or with thickened walls, (2) gaseous shadows or residual barium in the gallbladder or hepatic ducts, (3) any abnormal opaque area in the gallbladder region.

A definite gallbladder shadow is indicative of gallbladder disease. In a series of 14 gallbladder carcinomas, 7 showed abnormal soft-tissue shadows. Gas in the gallbladder walls and adjacent tissue is pathognomonic of emphysematous cholecystitis, and gas in the biliary tree points to a fistulous gastrointestinal communication.

The greatest scout film yield is the demonstration of abnormal calcification. In the gallbladder wall, this indicates previous disease. Opaque calculi indicate cholecystitis or occasionally extrabiliary stone-forming disease. In most cases of acute cholecystitis a calculus is impacted in the cystic duct and recognition of a single stone medial to a collection of calculi is an aid in diagnosis. Differential diagnosis is not difficult where a gas shadow or primary gallbladder shadow is concerned, but opaque gallstones must be differentiated from renal, hepatic and pancreatic calculi, from calcified mesenteric nodes, calcified rib cartilages, residual barium, and opaque foreign bodies. Identification of adjacent soft-tissue shadows of liver, kidney, hepatic flexure, and duodenum on good quality films is helpful. The liver edge, the hepatic flexure, and the first two portions of the duodenum localize the gallbladder area, even in extremes of position or transposition.

One roentgenogram; 3 drawings.

WALTER M. WHITEHOUSE, M.D.
University of Michigan

**Present-Day Cholecystography.** B. R. Kirklin and D. Brendan O'Donnell. J.A.M.A. **151**: 261–263, Jan. 24, 1953.

The history of cholecystography is briefly reviewed, with emphasis on the importance of careful technic in obtaining films and their "cautious, well-reasoned interpretation." The current procedure used by the authors is then reviewed. The patient is given six 0.5-gm. tablets of iodo-alphionic acid (Priodax) to be taken during or immediately after a fat-free meal at 6:00 P.M., with nothing by mouth afterward except water, black coffee, or clear tea. The following morning he takes rectal injections of warm water an hour and a half and an hour before reporting for examination. The first set of films, made with the patient prone, consists of two or three 8 × 10-in. films covering the right side of the abdomen. The Potter-Bucky diaphragm is used with a 36-in. distance. These initial films are scanned to localize the gallbladder and to ascertain if stones are present. The second set of films is made about two hours later on a special table which can be rotated on its long axis. The patient is held prone on the table by a canvas binder and the table is revolved to an angle of 90 degrees, with loosening of the binder temporarily to permit visceral rearrangement. In this right lateral decubitus position, the gallbladder usually falls free from the spinal column and bowel. Two 8 × 10-in. films are then exposed over the predetermined gallbladder site. The third set of films is obtained two or three hours after the second set and one hour after the ingestion of 6 oz. of 20 per cent cream. With the patient again prone on the table, two films are exposed. Usually the two positions described are adequate. Occasionally further exposures in the upright position will be necessary. Positive diagnoses obtained with this technic have reached an accuracy of 98 per cent as proved by operation.

Eight roentgenograms; 2 photographs.

WALTER M. WHITEHOUSE, M.D.
University of Michigan

**Cholangiography by Means of a Barium Enema.** R. H. Franklin. Brit. M. J. **1**: 140–141, Jan. 17, 1953.

The inflamed gallbladder containing stones not infrequently becomes attached to a neighboring hollow viscus, and on occasion a stone may ulcerate into the intestinal tract with fistula formation. Persistence of the fistula may be due to another stone blocking the common duct, as in the following case.

A 70-year-old diabetic patient had severe diarrhea.

with pale yellow liquid stools containing no blood or mucus. No weight loss was noted. Sigmoidoscopy showed no abnormality, but a barium enema study revealed a fistulous communication between the hepatic flexure of colon and gallbladder. The barium passed along what was thought to be the common duct, showing a filling defect believed to be due to a stone at the ampulla of Vater. Operation substantiated the findings and after removal of stones from the common and hepatic ducts, division of the fistula, and cholecystectomy, the patient made an uneventful recovery.

One roentgenogram.

L. R. JAMES, M.D.
Boston, Mass.

**Operative Cholangiography.** Milford B. Hatcher and Max Mass. J. M. A. Georgia **41**: 556–559, December 1952.

The authors recommend routine operative and postoperative cholangiography. The former is done as soon as the abdomen is open by injecting the contrast medium through a needle into common duct, cystic duct, or even the gallbladder. The film is studied prior to further operative procedure, as it gives information as to the position of the extrahepatic biliary system and any variations which may be present. A properly made and interpreted cholangiogram at this stage may make exploration of the common duct unnecessary. It will demonstrate stones, strictures, spasm, tumors, and extrinsic obstructions. In secondary operations, especially, exposure of the extrahepatic biliary system by cholangiography is most useful.

Technically, the procedure is facilitated by incorporation of a Potter-Bucky unit in the operating table. A portable unit sufficiently powerful to make exposures not exceeding one second is used. The patient's respiration is suspended by the anesthetist during the procedure.

Postoperative cholangiography may be performed seven to twelve days after operation. Of 51 routine cholangiograms obtained after choledocholithotomy, 7 showed residual stones. The authors find that palpation and instrumentation afford little assurance that all calculi have been removed from the common duct.

Six roentgenograms.

M. HARLAN JOHNSTON, M.D.
Jacksonville, Fla.

**Peroperative and Postoperative Cholangiography.** Everett L. Pirkey, Lawrence A. Davis, and Lawrence A. Pilla. J.A.M.A. **151**: 266–268, Jan. 24, 1953.

The history of cholangiography is briefly reviewed, together with the indications for peroperative cholangiography, which are the same as those for surgical exploration of the common duct: (1) history of jaundice, (2) thickening or dilatation of the ducts, (3) small fibrotic gallbladder, (4) hepatic cirrhosis, (5) small stones in the gallbladder, (6) thickened muddy bile, (7) suspected or palpated stone in the common duct, and (8) enlargement of the head of the pancreas.

The author's peroperative method calls for the insertion of a ureteral catheter in the cystic duct, which is ligated to prevent backflow into the gallbladder. Twenty cubic centimeters of aqueous emulsion of ethyl iodophenylundecylate (Pantopaque) are injected through the catheter, and a film is exposed near the end of the injection. During film development, the cholecystectomy is completed. If cholangiographic abnormality is present, common duct exploration is undertaken.

Postoperative cholangiography is done prior to the removal of the T-tube following cholecystectomy or cholecystostomy to determine the patency of the duct system and the presence or absence of stones. Ethyl iodophenylundecylate is also used for this procedure.

Two roentgenograms; 2 drawings.

WALTER M. WHITEHOUSE, M.D.
University of Michigan

## THE MUSCULOSKELETAL SYSTEM

**Osteochondritis Dissecans in Children.** William T. Green and Henry H. Banks. J. Bone & Joint Surg. **35-A**: 26–47, January 1953.

Reports on osteochondritis dissecans in children have been few. In this paper the authors record their experience with 27 cases, all occurring before the age of fifteen. Seventeen patients were under twelve years and 6 were between four and nine years. Thirty-six joints were involved: 32 knees, 3 elbows, and 1 ankle. Eight patients had lesions in more than one joint. The sites of the lesions in the knees (24 patients) were as follows:

| | Unilateral | Bilateral |
|---|---|---|
| Medial femoral condyle | 13 | 5 |
| Lateral femoral condyle | 2 | 1 |
| Medial and lateral condyles | .. | 2 |
| Patella | 1 | .. |
| TOTAL | 16 | 8 |

The patients with osteochondritis dissecans showed a high incidence of osteochondritis of the ordinary type in other areas. Three had Osgood-Schlatter disease, 1 had osteochrondritis of the lower pole of the patella, and 2 had extensive osteochondritis of the spine.

Only 8 of the 27 patients gave a history of trauma which it was felt might be associated with the onset of their difficulty. A history of recurrent pain was the rule. Other common complaints included soreness, stiffness, giving way, clicking, and occasional swelling.

The authors state that while the diagnosis of osteochondritis may be suspected from the clinical history and physical findings, it can ordinarily be confirmed only by roentgenograms. These show a crater-like area of rarefaction affecting the articular subchondral bone, just as in the adult. In more than half of the authors' cases the lesions contained fragments resembling loose bodies or sequestra. In 75 per cent of the knees, the medial femoral condyle was involved in its lateral portion, with the process often extending to the margin of the intercondylar fossa adjacent to the posterior cruciate ligament. Most lesions were recognized in ordinary anteroposterior and lateral projections. The authors recommend, also, a postero-anterior tunnel view to visualize the posterior portion of the condyles and the intercondylar notch. This view is obtained by placing the patient prone, flexing the knee to 60 degrees, and then directing the tube in a caudad direction so that the ray intercepts the joint at an angle of between 20 and 40 degrees, depending upon how far posteriorly in the condyle one wants to emphasize the visualization.

Of the 36 joints affected, 9 were treated surgically and evaluation after one to twelve years revealed excellent

results in 2 cases and good in 6 cases; 1 was unclassified. Of 25 joints receiving non-operative treatment, 18 had been followed for more than one year. Seventeen were classified as showing excellent results and 1 was unclassified. Non-operative treatment included Thomas patten-bottom braces and plaster leg cylinders. The brace was worn for an average of seven months, though the authors feel that five months would be adequate. Cylinders were worn for an average of four months.

From this series the authors conclude that osteochondritis is not uncommon in children and that, when the lesion is protected, prompt healing may be expected. This can occur even in patients in whom there is apparent sequestrum formation within the confines of the cavity of the osteochondritic lesion. Protection is the treatment of choice in children, provided there is no loose body in the joint and provided the clinical manifestations subside promptly.

Forty-eight roentgenograms; 4 photomicrographs; 4 tables.

BERTRAM LEVIN, M.D.
Minneapolis, Minn.

**Coccidioidomycosis of Bone in Children.** J. Dykes, J. K. Segesman, and J. W. Birsner. Am. J. Dis. Child. **85:** 34–42, January 1953.

Osseous coccidioidomycosis in children occurs as a dissemination of the disease. Twenty-six cases obtained from the files of Kern General Hospital, Bakersfield, Calif., in children up to ten years of age, form the basis of this report. The data for the series are presented in tabular form, and 3 cases are reported in fuller detail.

Roentgenograms demonstrate osteolytic lesions of bone resembling those seen in adults with the disease. Any bone may be affected. Multiple lesions occurred in 8 of the cases reviewed. The disease, as in adults, appears more frequently in Mexicans and Negroes, but there is apparently no age predilection.

The chief complaints were painful tender swellings. When a single area was involved, there was frequently a history of injury to the site.

Contrary to the usual opinion, involvement of bone by coccidioidomycosis in children does not in itself connote a severe disease with fatal outcome. The lungs may be involved as well as the skeletal system, the pulmonary lesions frequently preceding bone involvement. The process, as a rule, is chronic, with relatively good prognosis for eventual recovery.

Eight roentgenograms; 2 photographs; 2 tables.

LAWRENCE R. JAMES, M.D.
Boston, Mass.

**A Congenital Bone Disease Simulating an Atypical Eosinophilic Granuloma.** Rudolf Garsche. Fortschr. a. d. Geb. d. Röntgenstrahlen **78:** 63–70, January 1953. (In German)

The author discusses the classification of eosinophilic granuloma and its possible relationship to reticulosis—Letterer-Siwe's disease and Schüller-Christian disease—and reports a case observed in a newborn child and diagnosed by biopsy. The patient showed marked swelling of the right leg with considerable alteration of the bony texture of tibia and fibula. The x-ray findings resembled those of a chronic osteomyelitis. A biopsy from the tibia showed dense infiltrations formed predominantly by eosinophilic leukocytes. The diagnosis was eosinophilic granuloma. The swelling of the leg and the bone changes gradually subsided in two and a half years except for a small area in the shaft of the tibia. This region received x-ray therapy (8 × 200 r) and six months later showed a normal texture. A repeat biopsy showed only scarring. This is probably the first reported case of an eosinophilic granuloma in a newborn child.

Three roentgenograms; 2 photographs.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

**An Unusual Osseous Sequel to Infantile Scurvy.** Frederic N. Silverman. J. Bone & Joint Surg. **35-A:** 215–220, January 1953.

Permanent deformities resulting from scurvy are extremely rare. The author submits a case report as an example of permanent skeletal deformity following infantile scurvy and probably resulting from it.

The patient was born at term and until admission to the hospital at six months of age had been on a diet consisting exclusively of whole milk and water. He had received vitamin-D concentrate, beginning in the fifth month but no vitamin C. He weighed 9 pounds 8 ounces at birth and 14 pounds 7 ounces at six months. He was admitted because of recurrent otitis media.

On the day following admission swelling and tenderness of the right thigh and leg were noted. A chest roentgenogram showed the bones of the thorax to be osteoporotic, while the sternal ends of all the ribs were irregularly mineralized, spread, and cupped. Films revealed a large soft-tissue swelling over the right thigh, dislocation of the right distal femoral epiphysis, and evidence of early subperiosteal new-bone formation. All of the bones were diffusely osteoporotic, but the calcified cartilage at the ends of the shafts were relatively dense. A subepiphyseal fracture was present at the medial border of the distal left femoral epiphysis. The findings were considered characteristic of scurvy and with high dosage of ascorbic acid the thigh swelling and tenderness disappeared. Follow-up films revealed the characteristic bell-shaped subperiosteal calcification of healing scurvy in the distal end of the shaft of the right femur.

One year later the child was again brought to the hospital because of a gait disturbance. Roentgenographic examination of the femora showed the right distal epiphysis to be impacted into the shaft of the femur in a "ball-and-socket" fashion. There was appreciable shortening of the right femur. This was thought to represent the result of fracture of the brittle epiphyseal plate during the active phase of scurvy. The author notes that not infrequently fractures occur through the calcified cartilaginous epiphyseal plate and are manifested by discontinuity of the dense line of this disk. Generally only the calcified cartilaginous plate and a small amount of the adjacent cartilage is injured. In this case the fracture must have traversed the entire thickness of the cartilage to the ossification center for the epiphysis. It extended through the layers of proliferating and resting cartilage so that premature fusion of the ossification center for the epiphysis and the shaft at the site of fracture took place. There was no interference with the surrounding area of epiphysis, and peripheral to the area of fracture and fusion there was no growth cessation. Peripherally, growth was at a normal rate and as a result the epiphysis became embedded in the shaft.

Five roentgenograms.

BERTRAM LEVIN, M.D.
Minneapolis, Minn.

**Osteopetrosis in an Adult. A Case Report.** George R. Callender, Jr., and George Miyakawa. J. Bone & Joint Surg. **35-A:** 205–210, January 1953.

The authors report the case of a 29-year-old male who came to medical attention because of a fracture of the right hip following minimal trauma. The patient had previously suffered fractures of a femur, clavicle, and humerus, and had had a left below-the-knee amputation when he was run over by a train. Roentgenograms of the skull, long bones, ribs, hands and feet, spine, and pelvis revealed the characteristic appearance of osteopetrosis.

The hip fracture had gone untreated for some time, resulting in non-union. This necessitated removal of the femoral head and insertion of a prosthesis. Great difficulty was experienced in producing a tract for this purpose, because of extreme hardness of the bone.

A roentgenogram of a thin section of the resected femoral head shows clearly the characteristic bands of increased density.

Eleven roentgenograms; 4 photomicrographs.

BERTRAM LEVIN, M.D.
Minneapolis, Minn.

**Chordoma. A Study of Fifty-nine Cases.** David C. Dahlin and Collin S. MacCarty. Cancer **5:** 1170–1178, November 1952.

The authors report a study of 59 histologically verified cases of chordoma from the files of the Mayo Clinic, covering the period 1910 through 1951. Thirty-two of the tumors were found in the sacrococcygeal area, 15 at the base of the skull, 9 in the cervical area, 2 in the lumbar and 1 in the thoracic region of the spinal column.

Roentgenographic examination was the only laboratory procedure of aid in making the diagnosis of chordoma. Roentgenograms of the sacrum, or records of them, were available in 27 of the 32 cases with tumor in the sacrococcygeal area and in only 3 was this study non-contributory. The sacrum and occasionally also the coccyx showed varying degrees of destruction in 19 of the group. In several of these the diagnosis was strongly suggested by the roentgenologist. In 3 cases there was questionable erosion of the sacrum, and in 2 others soft-tissue masses were visualized anterior to the sacrum. Hsieh and Hsieh (Radiology **27:** 101, 1936) described four cardinal roentgen features of sacrococcygeal chordoma: expansion of the sacrum in its anteroposterior or lateral diameter, areas of rarefaction or destruction that tend to be loculated, trabeculation of the undestroyed bone with a tendency for this process to extend into the extraosseous portion of the tumor, and areas of calcification within the tumor. Camp and Good (Radiology **31:** 398, 1938) found that chordoma is the commonest primary sacral tumor with positive roentgenological findings.

The sacrococcygeal tumors presented chiefly as presacral pain-producing masses. Considerable palliation was afforded patients so afflicted by either surgical intervention or irradiation alone or the two procedures in combination. One patient was apparently relieved by the combination, but reasonable hope of permanent cure probably depends on the more radical surgical treatment now employed. Roentgen therapy produced palliation in 2 cases.

Chordomas arising in the spheno-occipital area have, with rare exceptions, a hopeless prognosis. Any of the cranial nerves, but especially those concerned with the eyes, may be affected. Roentgenography is of the utmost importance in this group. Such studies were performed in 14 of the authors' cases, and in only a single instance did they fail to reveal some evidence of the lesions. Biopsy of the sphenoid sinus will often verify the diagnosis. One patient in this group has survived 18.7 years after surgical excision.

Chordomas affecting the spinal column may present from any side of the vertebrae or intervertebral disks, but they ordinarily cause neurological signs and symptoms by compression of the spinal cord or nerve roots. In 10 of the authors' 12 cases roentgenograms revealed destruction of bone; in the remaining 2, soft-tissue masses were visualized anterior to the cervical spine. Surgical excision produced prolonged remissions in 2 of the patients in this group.

Eight illustrations, including 1 roentgenogram.

**Primary Reticulum-Cell Sarcoma of Bone.** Lawrence J. McCormack, John C. Ivins, David C. Dahlin, and Einer W. Johnson, Jr. Cancer **5:** 1182–1192, November 1952.

During a recent study of Ewing's sarcoma conducted at the Mayo Clinic, a group of tumors of bone which in some cases closely resembled Ewing's tumor, was segregated on the basis of microscopic morphology from the group that was being studied. Oberling, Parker and Jackson, Edwards, and Coley, have previously reported bone tumors of similar morphology (see, for example, Coley *et al.:* Radiology **55:** 641, 1950). The authors call this tumor primary reticulum-cell sarcoma of bone. Thirty-two cases are reported.

Three types of gross configuration were noted. The first consisted of a circumscribed tumor mass limited to the bone and involving the epiphysis and contiguous diaphysis. The cortex surrounding the tumor was thickened. The second type was a large, pear-shaped mass involving the epiphysis and diaphysis, with destruction of involved bone. In a third type there was eccentric extraosseous extension of the tumor. Epiphysis and diaphysis were involved in two-thirds of this group.

Microscopically the tumors show considerable variation, ranging from those with a few typical reticulum cells to those composed completely of these elements. The necessary component for the diagnosis is the reticulum cell.

Spread was found to be by invasion of the surrounding tissue, especially muscle and fat. In regions away from the tumor, lymph-node involvement was demonstrated in 6 of 32 cases.

The anatomical localization of the 25 solitary lesions emphasized the tendency to involvement of the extremities: 16 of the lesions were located in the innominate bone or other bones of the lower extremities; 8 were in the upper extremity or its girdle; 1 involved the body of the 7th thoracic vertebra. Seven patients had multiple bone involvement. The most common presenting complaint of the patients was pain.

Nothing distinctive about the roentgenologic appearance of the neoplasm was noted. The typical picture was that of osteolytic destruction, which is seen in so many neoplastic conditions of bone. The authors emphasize that roentgenologic examination has served its purpose when a lesion of bone has been discovered, and that the accurate diagnosis will come only after histologic examination of adequate biopsy material.

The authors present some data regarding survival of

these patients but point out that from a statistical standpoint any conclusions to be drawn are limited by the size of the series. Fourteen of the 25 patients with solitary lesions were alive for periods varying from seven to 347 months following the time of biopsy diagnosis. The average interval of survival was 139.5 months from the time of first treatment. Eleven of these 25 patients lived five or more years. In this group 5 were treated by roentgen therapy alone, 4 by a combination of amputation and irradiation, and 2 by amputation alone

Illustrative case reports are given.

Four roentgenograms; 2 photographs; 7 photomicrographs; 1 chart; 2 tables.

D. S. CHILDS, JR., M.D.
Rochester, Minn.

**The Rapid Development of a "Subperiosteal Bone Cyst" in Multiple Neurofibromatosis. A Case Report.** Cline D. Hensley, Jr. J. Bone & Joint Surg. **35-A:** 197–203, January 1953.

"Subperiosteal bone cyst" is apparently a common occurrence in the osseous involvement of neurofibromatosis. The author's case, however, represents only the fifth to be reported in which the cyst lay on the cortex of the involved bone and was covered by a lamella of new bone.

The patient was a white male first seen in 1940, at the age of two and a half years, because of a limp and a swelling on the medial aspect of the left ankle. At four years a mass was partially excised; it was a neurofibroma arising from the posterior tibial nerve. At that time the left tibia measured 1.5 cm. longer than the right. Overgrowth of the left lower extremity continued and stapling of the tibial and fibular epiphyses was done in 1946. By 1949 the left foot showed marked equinovalgus with severe plantar flexion of the talus and a triple arthrodesis was done. The following year, when the patient was thirteen, there developed a firm, slightly tender mass over the lower third of the left tibia on its anteromedial surface. Roentgenograms showed a rounded soft-tissue density overlying the subcutaneous surface of the bone. One month later repeat films revealed a large dense shadow along the surface of the tibia at and just below the juncture of the middle and lower thirds of the shaft. At operation a subperiosteal bony mass 3 × 5 cm. was found attached to the surface of the tibia. It did not erode or penetrate the tibial cortex. The overlying periosteum was thickened. The bony shell consisted of a thin layer of soft cancellous new bone; the body of the mass was made up of firm, rubbery, white fibrous tissue. Microscopic study led to the diagnosis of neurofibromatosis of the periosteum associated with the formation of a large bowl-shaped mass of immature bone.

The author concludes that the "subperiosteal bone cyst" consists of a neurofibroma which probably arises from a periosteal nerve, elevates the periosteum from the cortex, and stimulates the rapid formation of lamella of new bone, which partially encapsulates the tumor.

Six roentgenograms; 2 photographs; 3 photomicrographs.

BERTRAM LEVIN, M.D
Minneapolis, Minn.

**Technique and Value of Myelography.** Frank L. Shipp. J.A.M.A. **151:** 185–188, Jan. 17, 1953.

This article, based on experience with over 3,000 patients examined at the Lahey Clinic (Boston, Mass.), discusses the indications for myelography and its technic. In over 1,800 instances in which Pantopaque has been used, there have been no significant complications attributable to the medium. The procedure is advised in general for all cases in which operation is contemplated in which other studies have proved inconclusive. Although the author considers it a relatively atraumatic procedure, he does not recommend it for patients who are emotionally unstable.

Preparation for the procedure includes administration of laxatives and of analgesics in moderation. The patient is placed prone for the lumbar puncture and the needle is inserted in the mid-line between L-3 and L-4 and left there during the examination. By use of this interspace, one avoids the commonest sites of disk protrusion—the fourth and fifth lumbar levels. Also, it makes possible easier withdrawal of the medium, since it is the most dependent portion of the curvature with the patient prone. The Pantopaque (6 c.c.) is injected slowly under fluoroscopic control. Fluoroscopic observations are made in both oblique projections, as well as the lateral when necessary. In all disk investigations the study is carried at least as far as the 8th dorsal segment. Fluoroscopy is supplemented by spot-filming in appropriate planes. Routine anteroposterior and both oblique films of the third, fourth, and fifth lumbar interspaces are taken in examining the lumbar spine. Examinations of the cervical region include anteroposterior and both oblique films of the cervical spine and the cervicodorsal junction. In the dorsal region, films are taken as dictated by the circumstances. The cul-de-sac is examined with the patient upright.

Helpful suggestions are offered concerning injection and removal of the medium, prevention of globule formation, and after-care. For those doing this procedure, the original article is well worth reading.

DAVID D. ROSENFELD, M.D.
Fontana, Calif.

**Lateral Intervertebral Disk Lesions in the Lower Cervical Region.** R. Glen Spurling and Ludwig H. Segerberg. J.A.M.A. **151:** 354–359, Jan. 31, 1953.

Two types of lesions, producing similar radicular symptoms, may involve the lower cervical disks. The first consists of localized osteoarthritic changes and narrowing of the disk interspace. Osteophytic spurs encroaching upon the intervertebral foramens cause compression of the nerve root. The second type is acute posterolateral rupture of a disk, with direct compression of the nerve root. There is no spur formation and no disk narrowing. Rupture of a cervical disk occurs laterally with great frequency because the posterior longitudinal ligament does not reach the lateral margin of the disk. In addition, the annulus fibrosus of each disk is weakest at its posterolateral margins.

Radicular pain in the lower neck, shoulder, and arms is the commonest symptom with lesions of the lower cervical disks. Of 33 surgically proved cases of disk disease reported by the authors, 30 per cent occurred at the fifth cervical level, 60 per cent at the sixth, and 10 per cent at both fifth and sixth levels.

Roentgen examination in the anteroposterior, lateral, and both oblique projections will reveal several important features, including obliteration of the cervical lordosis and narrowing of the disk interspace, with osteophytic spurs deforming the contour of the intervertebral foramen, particularly its anterior wall. The

latter finding is not infrequent in asymptomatic individuals but cannot be ignored in patients complaining of pain in the upper extremity or neck.

When operation is contemplated, myelography with Pantopaque is desirable. The myelographic deformity characteristic of lateral cervical disk rupture consists of a small indentation in the lateral margin of the opaque column, with obliteration of the corresponding axillary pouch. Osteophytic spurs may cause pressure on the nerve in the intervertebral foramen, with minor or no myelographic findings. A negative myelogram, therefore, may rule out rupture of the disk, but does not exclude nerve compression by osteophytes.

Differential diagnosis, treatment, and results in 110 patients showing evidence of root compression in the lower cervical region are discussed. The authors reserve surgical intervention for those patients who fail to respond to traction therapy. In this series, 70 per cent of patients obtained satisfactory results from conservative measures alone.

Six figures, including 3 roentgenograms.

DAVID D. ROSENFELD, M.D.
Fontana, Calif.

**Tuberculosis of the Spine and Its Differential Diagnosis.** J. E. W. Brocher. Ergänzungsband 68, Fortschr. a. d. Geb. d. Röntgenstrahlen, 1953.

Some 10 per cent of all cases of Pott's disease go for years undiagnosed. An additional 10 per cent of all cases referred for sanatorium care as proved spondylitis tuberculosa are incorrectly diagnosed. Because of this and because definitive treatment is available for this as well as the diseases commonly confused with it, early, accurate diagnosis is important. The classic triad of gibbus, cold abscess, and paralysis of the legs is today rarely seen in other than grossly neglected cases. Since 1900, tuberculosis of the spine has tended to lesser virulence, a lower incidence, a more frequent lumbar localization, and occurrence in older individuals. The age distribution is approaching that of the relatively common Scheuermann's disease and the fairly common spondylitis ankylopoietica. The answer to proper differential diagnosis is obvious: a good radiographic examination followed by intelligent interpretation.

Brocher's monograph, with one-third of its length on a subject quite neglected in recent years, can provide both the internist and the radiologist with a working foundation in Pott's disease. Although the book is clinical in attitude, spine diagnosis is only a cipher without the x-ray. The work is thus a roentgen text. All but 6 of the 376 illustrations are reproductions of roentgenograms. The two chapters on spondylitis ankylopoietica and Scheuermann's disease are forthright, precise, as apt and practical as any in modern writing. Other entities considered are non-tuberculous infectious spondylitis, block vertebra, limbus vertebra, vertebra plana, developmental anomalies, osteochondrosis, osteomalacia, metastatic and primary tumors.

[This monograph is unusual in that it is worth its relatively high price.] WM. F. WANGNER, M.D
Royal Oak, Mich.

**Incidence of Tumor Metastasis to the Lumbar Spine. A Comparative Study of Roentgenographic Changes and Gross Lesions.** J. M. Young and F. James Funk, Jr. J. Bone & Joint Surg. **35-A:** 55–64, January 1953.

The frequency of terminal tumor metastasis to bone has been variously estimated at from 10 to 40 per cent. The present study was undertaken in an attempt to better determine the frequency of bone metastasis. In 74 consecutive cases of fatal tumor in which autopsies were done, the lumbar portion of the spine was removed. Roentgenograms of the specimen were obtained in the anteroposterior and lateral positions and it was then sliced into multiple sections lengthwise in the anteroposterior direction. Multiple sections were taken from each specimen for microscopic study.

Gross metastases were found in 30 cases, an incidence of almost 41 per cent. In only 13 cases did the roentgenograms disclose significant lesions, even though there were no overlying soft-tissue shadows. Osteolytic foci appearing in roentgenograms lagged far behind the amount of destruction actually present.

The incidence of 41 per cent is all the more striking when one considers that these cases are from a Veterans Hospital and that not one of the 74 tumors was of the thyroid, breast, or female genital tract.

Eleven roentgenograms; 6 photographs of gross specimens; 7 photomicrographs. BERTRAM LEVIN, M.D.
Minneapolis, Minn.

**Scoliosis and Dissecting Aneurysm of the Aorta in Rats Fed with Lathyrus odoratus Seeds.** Ignacio V. Ponseti and William A. Baird. Am. J. Path. **28:** 1059–1077, November–December 1952.

It was believed that a study of scoliosis produced in rats by a diet containing 50 per cent pea meal (ground *Lathyrus odoratus* seeds) might throw some light on the cause and evolution of idiopathic scoliosis in man. In a large group of children with this disease, the protein metabolism had been found at fault.

The roentgenographic, clinical, and histopathologic findings in 16 animals are described. All had kyphoscoliosis, and in 6 there were associated aneurysms of the thoracic aorta. Roentgenograms taken after two or three weeks of the pea meal diet indicated that the scoliosis was the result of osteoporosis and collapse of several vertebrae. It is believed that the pea meal contained a toxic factor affecting the formation of organic bone matrix, the aorta, and possibly other mesodermal structures. In animals returned to a stock diet, the scoliotic process became arrested.

Eight roentgenograms; 10 photomicrographs; 1 graph.

**A New Contribution to the Study of Carpal Variations.** Th. Marti. Schweiz. med. Wchnschr. **83:** 52–54, Jan. 17, 1953.

While in many cases skeletal variations may be of little clinical significance, in other instances they may produce characteristic pathological symptoms and may be of great importance, especially in legal or insurance matters. As examiner for the Swiss Accident Insurance Company of Geneva, the author describes and illustrates 3 cases in which the clinical and final findings were at variance with the report of the radiologist. In the first case the x-ray diagnosis was non-union of the styloid process of the ulna and os triangulare. The history and clinical findings led to a diagnosis of pseudarthrosis after a typical Colles' fracture. In support of this latter diagnosis, callus-like bone proliferation and condensation of the bone structure are mentioned. The so-called os triangulare probably represents a fragment from the articular surface of the distal portion of

the ulna. The os triangulare as a real bone variety is rejected clinically by the author, who considers references to an os triangulare or an os intermedium antebrachii in the radiological literature as obsolete.

The second case was observed in a man in whom, after a fall from a ladder, the radiological diagnosis of an avulsion fracture of the ulna (styloid process) had been given. According to the author, the well circumscribed round ossicle observed in the region of the styloid process of the ulna represented an accessory bone, the os pisiforme secundarium.

In the third case, pain and swelling in the region of the bases of the first and second metacarpals were attributed by the surgeon to a fracture of the first metacarpal. The roentgenogram showed no fracture but an accessory ossicle distal to the junction of the multangulum majus and the hamate bones. The diagnosis of the radiologist was os hamuli proprium. According to Marti, this radiologic diagnosis is incorrect, and the observed ossicle must be considered a variation in the region of the multangulum majus, probably as the so-called pretrapezium.

Five roentgenograms. ERNST A. SCHMIDT, M.D.
Denver, Colo.

**Aimed Pneumarthrography of the Knee Joint.** H. J. Nidecker. Radiol. clin **22:** 10–28, January 1953. (In German)

Meniscus injuries play an important role among the intrinsic injuries of the knee joint. Their clinical diagnosis is often rather difficult, and may occasionally be almost impossible. The customary anteroposterior, lateral, and oblique radiographs are for the most part of no diagnostic aid.

As early as fifty years ago attempts had been made to visualize the soft-tissue structures of the knee joint. First, oxygen or air and later opaque contrast media were used. Some examiners, like Oberholzer (Beitr. z. klin. Chir. **158:** 113, 1933), used oxygen and Perabrodil in a double-contrast method.

The author describes his new technic and presents a few cases of meniscus injuries. He regards pneumarthrography as an important method of investigation for the intrinsic injuries of the knee joint and attributes failures to the use of the "blind" method.

The diagnostic accuracy of pneumarthrography is not dependent on the type of contrast medium but exclusively on the technic used. He observes the knee joint fluoroscopically, turning and rotating the knee in various diameters. In positions in which changes are best visible, spot films are taken. This aimed technic is compared with the present x-ray examination of the stomach, where spot filming in oblique positions is a well established method.

Fluoroscopy in addition permits a study of the function of the joint and of the cartilages in particular. Aimed serial spot films, taken during fluoroscopy, represent a permanent distinct recording of the changes observed, helping in the diagnosis and suggesting the required surgical reconstruction.

Twenty-three roentgenograms; 31 drawings.
HERBERT C. POLLACK, M.D.
Chicago, Ill.

**A Rare Variation of Ossification of the Phalanges of the Toes.** Y. Laurent and M. Brombart. J. belge radiol. **36:** 102–106, 1953.

A female child was first radiographed at the age of three years because of ill-defined pain in the feet. Roentgenograms showed the epiphyses of the second, third, and fourth toes of both feet to be cone-shaped, with the apex of the cone projected into the shaft of the phalanx, producing an appearance somewhat like that of a cork in a water bottle. Radiographic examination one year later revealed the same appearance. It was believed that this is a developmental anomaly of no clinical significance.

Two boys, aged thirteen and fourteen, were found to show a similar appearance.

Four roentgenograms. CHARLES NICE, M.D.
University of Minnesota

**Pancreatic Function and X-Ray Studies in Psoriasis.** John F. Madden and Irvine M. Karon. Arch. Dermat. & Syph. **67:** 66–75, January 1953.

Studies of pancreatic function were performed on 15 psoriatic patients, aged six to seventy-two years, 8 males and 7 females, whose lesions varied from guttate papules to large plaques. The patients were hospitalized, and the fat and nitrogen contents of the feces and the amounts of amylase and lipase in the blood serum were recorded. All results were within normal limits except for 3 patients in whom the nitrogen and fat contents of the feces were slightly low. This was considered within the limits of technical error.

X-ray studies were carried out in 30 unselected cases of psoriasis. Fourteen patients complained of joint pains; in the remaining cases there were no complaints or clinical manifestations of arthritis. The patients ranged in age from eight to sixty-eight years; 18 were males and 12 females. In those who had arthritic symptoms, the duration of the arthritis varied from one to thirty-three years. Roentgenograms were made of both hands and both feet of each patient, and, in those with specific joint complaints, of the involved joints as well.

On the basis of the x-ray findings, the authors are unable to agree with those who state that in arthritis associated with psoriasis (*a*) there must be involvement and destruction of terminal interphalangeal joints; (*b*) the most severe roentgen changes occur in patients who have the greatest nail involvement; (*c*) the arthritic changes are limited to the hands and feet; (*d*) the destruction of bone must start at the distal joint surface. They often found nail changes in psoriatics who did not manifest either clinical or roentgenologic evidence of arthritis, while in other cases x-ray evidence of arthritis was encountered in the interphalangeal joints with no nail involvement of the same digit.

Without clinical information, roentgenologists are unable to state whether any given case of arthritis is psoriatic. The authors believe that the association of psoriasis and arthritis is casual and not specific and should, therefore, be designated as psoriasis with rheumatoid arthritis rather than psoriatic arthritis. Nothing in their studies indicated that psoriasis predisposes to arthritis or that the reverse is true.

Three tables.

## THE SPLEEN

**Post-Traumatic Intermittent Splenic Hemorrhage. A Case Report.** George A. Olander and Arthur F. Reimann. Ann. Surg. **137:** 104–107, January 1953.

Traumatic rupture of the spleen is usually diagnosed on the basis of a clear-cut history of trauma, episodes of

syncope and evidence of shock, left upper quadrant tenderness and rigidity, and radiologic demonstration of displacement of the gastric gas bubble. Paracentesis may show evidence of peritoneal hemorrhage. In extensive trauma, respiratory and thoracic findings have been present.

With delayed hemorrhage, there is pulp maceration associated with capsular tears and organized blood clot under or about the splenic capsule. Free blood is usually present in the peritoneal cavity.

In the case recorded here, trauma had occurred two years earlier, when the patient was struck on the left side by an automobile. He appears to have had no definitive treatment at that time and no immediate symptomatology. During the four months prior to study he experienced several episodes of pain in the left lower chest radiating to the epigastrium and some syncope. He became worse one week before admission and had a productive cough.

Physical examination showed evidence of left hydrothorax and increased resistance to palpation in the left upper abdominal quadrant. The spleen edge could not be felt. There were secondary anemia and leukocytosis. Thoracentesis showed dark bloody fluid on several occasions.

Radiography of the chest revealed evidence of hemothorax on the left. Various studies of the left upper quadrant with barium in the stomach showed the fundus of the stomach to be depressed and separated from the diaphragm, with displacement medially and forward by a mass in the region of the spleen. A fluid level within the mass and under the diaphragm was noted in the upright position.

At operation a round smooth mass including the spleen was removed. On section the mass was found to be a large cystic structure filled with new and old blood and enclosed by a thick fibrous capsule. It was considered to be a chronic extracapsular hematoma.

Six illustrations, including 3 roentgenograms.

BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

## THE GENITOURINARY SYSTEM

**On the Routine Use of Pitressin in the Preparation for Excretory Urograms, in Accordance with Trueta's New Concept of Intrarenal Circulation.** Ernesto Santander. Radiología **3**: 25–32, December 1952. (In Spanish)

Pitressin is recommended in routine preparation for intravenous urography; the hormone is administered twenty minutes before injecting the iodized material and films are taken five, fifteen and thirty minutes after the injection. Shadows cast by intestinal gas are thus reduced or abolished, and the antidiuretic action of pitressin results in increased concentration of the excreted contrast medium, and hence in clearer pictures. According to Trueta, pitressin diminishes the gomerular filtrate but the excretory function of the tubules continues undisturbed; thus the contrast medium is excreted at the same rate but into a small amount of hyperconcentrated urine. Contrary to the opinion of Lescano, pitressin does not act directly on the tubules and its use in urography thus does not constitute an additional test of renal function; if this were the case, it could not be used, as two tests of function would be superimposed, leading to confusion.

Review of a series of excretory urograms performed with and without preliminary injection of pitressin demonstrated the superiority of the former procedure.

J. BRACHFELD, M.D.
Philadelphia, Penna.

## GYNECOLOGY AND OBSTETRICS

**A New Water-Soluble Opaque Medium in the Study of Hysterograms and Hysterosalpingograms. Preliminary Report.** Maxwell Roland, Frederick Carpenter, and Joseph Rich. Am. J. Obst. & Gynec. **65**: 81–87, January 1953.

This report introduces a new water-soluble radiopaque medium, Medopaque-H, which was employed for 50 hysterosalpingograms and hysterograms in the study of sterility and endometrial disease. The series comprised 5 endometrial studies and 45 examinations for tubal patency.

The technic of injection of the medium is described. One hour after instillation no traces of Medopaque-H could be demonstrated anywhere in the pelvic cavity. It did not provide as sharp a contrast as iodized oil, but proved adequate to demonstrate the pelvic organs, as is shown by the illustrations. Since a 24-hour film cannot be obtained, the authors use a combined technic whereby carbon dioxide insufflation under controlled pressure is performed following Medopaque-H instillation to force the medium out into the peritoneal cavity, at which time films are obtained. The need for the 24-hour film is thus eliminated. Medopaque-H appears to be a useful radiopaque medium, innocuous to the pelvic organs, and rapidly absorbed.

Five roentgenograms.

JOHN H. KOHL, M.D.
Jefferson Medical College

## THE BLOOD VESSELS

**Aneurysms of the Middle Cerebral Artery.** Eldridge Campbell and C. W. Burklund. Ann. Surg. **137**: 18–28, January 1953.

Six cases of aneurysm are described. In 5 the diagnosis was confirmed by angiograms, and in 1 no angiographic evidence of aneurysm was obtained.

Both lateral and anteroposterior angiographic studies were made in all cases, and in most the aneurysm is clearly visible in the radiographic reproductions. No unusual technics for angiography are mentioned and most of the article deals with surgical technic and complications. In all cases the aneurysm was removed or obliterated. Four patients recovered with good results, and 1 with fair results; 1 died. The authors describe their method of temporarily occluding the afferent vessel with a noose of heavy silk to lessen the danger of rupture during isolation of the aneurysm.

Twelve figures, including 8 roentgenograms.

BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

**Portal Venography by Intrasplenic Injection.** R. Milnes Walker, J. H. Middlemiss, and E. M. Nanson. Brit. J. Surg. **40**: 392–395, January 1953.

An opaque medium (70 per cent Diodone) injected into the spleen is carried to the liver in sufficient concentration to demonstrate the course of the veins. The authors describe their technic of transparietal injection of the contrast medium into the spleen as applied in 12 patients. In 1 case, the material was apparently in-

jected between the layers of the gastrosplenic omentum, producing some pain for twelve hours, but the procedure was uneventful in the other 11 patients.

Roentgenograms are reproduced showing the normal course and configuration of the splenic and portal veins. The appearance of the collateral circulation associated with portal hypertension is also illustrated. The authors feel that the greatest value of these studies lies in the demonstration of veins suitable for a portal systemic anastomosis.

Seven roentgenograms; 6 diagrams.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

## TECHNIC

**Pneumoretroperitoneum by Presacral Insufflation.** H. R. Renfer. Radiol. clin. **22**: 29–43, January 1953. (In German)

The historical development of pneumoretroperitoneum, a procedure introduced by Rosenstein in 1921 to improve x-ray diagnosis in urology, is briefly discussed. Air, oxygen, and carbon dioxide were the agents most commonly used. Despite great care, a number of complications have been reported, such as air embolism, intestinal perforation, pneumothorax, and subcutaneous emphysema. Some of these proved fatal. For this reason, the method never came into general use.

Instead of using direct perirenal insufflation, the author introduces oxygen by the presacral route, injecting it through the *trigonum rectale*, between the anus and coccyx. Digital control of the needle point from the rectum protects against perforation. To obtain an optimal result, 1,000 to 1,800 c.c. of oxygen are generally required. This simplified method can be easily applied in clinical radiology and has proved particularly helpful in the diagnosis of primary and metastatic retroperitoneal tumors. The danger of complications is minimal. The only contraindication is an inflammatory process in the region of the anus and presacral space.

The author used this method in 28 cases without encountering any complication. Eight of these cases are briefly described to show its possibilities.

Ten roentgenograms; 2 photographs; 1 drawing.

HERBERT C. POLLACK, M.D.
Chicago, Ill.

**Prevention of Undue Intestinal Gas in Abdominal Radiography in Infants.** Å. Gyllenswärd, H. Lodin, and O. Mykland. Acta radiol. **39**: 6–16, January 1953.

Abdominal radiography is often complicated by the presence of large amounts of swallowed gas in the intestines, obscuring the underlying structures. To reduce the amount of intestinal gas, the authors keep infants one to fourteen months old lying prone the night prior to, the day of, and during the examination. The children receive a special viscous milk preparation which produces little gas, and are given sedatives to prevent crying.

About 30 examinations were carried out in accordance with this plan, and gas was present in the small bowel in only 2 instances. Though not infallible, the procedure results in very satisfactory roentgen films.

Sixteen roentgenograms. PAUL MASSIK, M.D.
Quincy, Mass.

## RADIOTHERAPY

**Some Aspects of Supervoltage Roentgen Therapy.** Frederick W. O'Brien, Jr. Am. J. Surg. **85**: 62–66, January 1953.

Generators and tubes for roentgen therapy apparatus in the range of 400 kv.p. to 2,000 and 22,000 kv.p. are currently being manufactured in more compact and flexible units. Ultrahigh-voltage characteristics are an increase in skin tolerance and an increase in percentage depth dose. Ionization at the skin level is reduced, and penetration is increased. The useful beam is improved since the tangential and forward scattering is minimized. The skin reaction is no longer a limiting factor. Therefore, caution must be used in assessing the deep tissue reaction, especially that of the mucous membrane. In cross-fire technic the increase in exit dose must be carefully considered. Protection factors concerning the patient, departmental personnel, and adjoining rooms become totally different from those for conventional 200-kv.p. therapy units. Supervoltage therapy does offer selected patients an increased chance for survival, but as yet no significant improvement has been noted in the overall survival rate.

Rotational therapy technics seem to be ideally suited to treatment of mid-line deeply situated lesions of the head and trunk. Rotation therapy at supervoltage levels would seem to offer more clinically than multiple-field or single-field ultrahigh-voltage therapy.

RICHARD F. MCCLURE, M.D.
Palos Verdes Estates, Calif.

**Radium Therapy with Beta Rays.** Juraj Körbler. Radiol. clin. **22**: 43–49, January 1953. (In German)

The author uses two beta ray applicators, one containing 5 mg. and the other 10 mg. of radium. The applicators are round, 1 cm. in diameter, and filtered by 0.1 mm. Monel metal. The 10-mg. plaque was applied for one hour in treatment of superficial skin cancers in 19 patients. In all cases a permanent cure was achieved with the additional advantage of short irradiation time. The 5-mg. plaque was used for treatment of verrucae vulgares on the hand, also being left in place for one hour. [There is no mention in the article as to the applicators being used in contact with the skin, although that would appear to be the case.—H. C. P.]

Hemangiomas in children were treated by the 10-mg. applicator for ten minutes or the 5-mg. applicator for twenty minutes, but not less. The results were very favorable.

In cases in which other methods of irradiation or other forms of treatment are of no avail, beta-ray irradiation may be successful. For instance, beta rays may give satisfactory results in naevus flammeus (portwine mark). Two such cases are reported.

In carcinoma of the cornea a cure can be achieved without damage to the optic nerve. Carcinomas of the eyelids were treated with beta rays with good results and without damage to the eye.

The author uses beta radiation from a radium source.

In future beta rays from isotopes, such as radioactive strontium, will probably be used.

Ten photographs. HERBERT C. POLLACK, M.D.
Chicago, Ill.

**A Small-Volume High-Dose Technique for the X-Ray Treatment of Some Brain Tumours.** Jan G. de Winter. Brit. J. Radiol. **26**: 22–31, January 1953.

A method of irradiating brain tumors through multiple small fields is described. After the tumor has been localized, the multiple fields are charted upon a model, so that as high a local dosage as possible with a small volume is given. As many fields as possible are arranged on the side of the lesion. A plaster cap is made to fit the patient's head, with a chin rest and spirit level, so that the position can be reproduced at each sitting. The beams are carefully directed into the small areas as worked out on the model. The method of charting the beams and setting the treatments is given in some detail.

Of 19 patients treated by this technic, all of whom were regarded as unsuitable for surgery, 13 were alive over two-and-a-half years after treatment. Most of the tumors were astrocytomas. Gliomas, meningiomas, and oligodendrogliomas were also treated.

The number of fields ranged from three to eight. The largest field was 8 cm. in diameter; most were between 4 and 6 cm. The maximum depth dose ranged from 3,900 to 7,700 r.

Sixteen illustrations; 1 table.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

**Treatment of Cerebral Tumours in Children by Irradiation.** Edith Paterson. J. Fac. Radiologists **4**: 175–189, January 1953.

The records of 83 children with cerebral tumors treated in the past twenty years at the Radium Institute, Manchester (England), have been analyzed. The author believes that, if treatment is embarked upon, it should be with a view toward cure, and that was the objective in the majority of this series. Fifty-eight tumors were subtentorial, 10 involved the midbrain, and 15 were situated within the hemispheres. Thus, 82 per cent were located within or adjacent to the cerebellum. These included all of the medulloblastomas and most of the astrocytomas.

Sixty-four of the cases were available for three-year results, and 39 of these were histologically proved. Actually the results in terms of survival were about the same for the proved and unproved cases—38.4 and 36.0 per cent, respectively, at three years. The following conclusions are based upon the verified cases.

None of the patients with glioblastoma (5) or ependymoma (7) survived for three years. Two of the glioblastomas showed improvement: 1 of these recurred in twenty-one months, while the other patient is well two and a half years after 4,250 r to the whole head in five weeks. Six of the 7 ependymomas were treated with cure in mind. One child was living two and a half years after treatment to the parietal region. All the others died within nine months.

Of 12 patients with astrocytoma treated more than five years previously, 5 were still alive, the average survival period being nine and a half years. Many of these were referred to the neurosurgeon because total removal could not be performed on account of the extent or position of the tumor. In most instances the tumor was small and localized, and a relatively high tumor dose was achieved. None of the 7 patients who died lived as long as a year.

For 22 patients with cerebellar medulloblastoma, the three-year and five-year survivals were 56 and 42 per cent, respectively. In these cases the entire central nervous system was irradiated, with a minimum tumor dose of 3,500 r in five weeks or 3,000 r in three weeks. In all of these cases exploration by the neurosurgeon and decompression preceded irradiation. This prevents a dangerous increase in intracranial pressure incident to the swelling that accompanies the early treatments. The first sign of recurrence in medulloblastoma has been found to be loss of weight.

Treatment technics are not included in this paper.

Five tables; 1 graph. I. R. BERGER, M.D.
VA Hospital, Atlanta, Ga.

**Radiotherapy of Intracranial Tumours in Children.** J. Jackson Richmond. J. Fac. Radiologists **4**: 180–189, January 1953.

Among 670 patients who received radiotherapy of intracranial tumors at St. George's Hospital, London, there were 110 children (16 years or less). Their average age was 8.8 years compared to 36 years for the group as a whole. The majority of the childhood tumors were in the cerebellum and brain stem. Gliomas predominated (85 cases), as in the adult group. There was only 1 meningioma and no pituitary tumor.

The author regards irradiation, to full tolerance, of a sufficiently extensive volume of brain tissue to include the tumor ramifications, as the basic principle of therapy. He believes that beam-directed small-field irradiation has met with disappointing results on many occasions because the conception of the pathological extent of the growth has been too restricted. For this series conventional high-voltage x-ray therapy in the 200 to 250-kv. range was employed. Formerly a beam of 1.5 mm. Cu half-value layer was used, but more recently the filtration has been increased to give a half-value layer of 3.5 mm. Cu. A minimum dose of 4,000 r in four weeks is prescribed for children twelve years old or older. One-half of this dose is given in infants of one year or less, and about 75 per cent at five years.

In the management of the course of therapy, the following precautions are followed:

1. Full confidence of the child is obtained.
2. Sedatives are used sparingly.
3. The treatment course is started with low dosages.
4. The white cell count is carefully watched and must be decreased or stopped if leukopenia develops.
5. After care of the scalp is important. Calamine lotion is used only if irritation develops.
6. Rehabilitation must receive special attention. It is a slow process and the child must not be pushed to make up lost time.

The study of interim results in this series shows survival rates in the various histologic groups as follows. The percentages are based on the number of cases available for three-year and five-year results respectively.

| | Three years | Five years |
|---|---|---|
| Medulloblastomas | 14 (50%) | 7 (43%) |
| Glioblastomas | 11 (73%) | 6 (83%) |
| Astrocytomas | 3 (100%) | 0 |

The author differs from Dr. Edith Paterson (see preceding abstract) in respect to therapy of gliomas of the embryonic type which tend to "seed" along the cerebrospinal pathways. He feels that the primary tumor must be treated initially for two reasons—early dramatic symptomatic relief may be obtained by delivering intensive treatment for a short time. This may aid in restoring muscle coordination to an ataxic child in addition to relieving symptoms due to increased intracranial pressure. Secondly, the drop in leukocyte count which may accompany treatment over the spinal cord will come at a time when diminished therapy or cessation of therapy will be less frustrating.

Three drawings; 8 tables. I. R. BERGER, M.D.
VA Hospital, Atlanta, Ga.

**The Postoperative Radiation Therapy of Carcinoma of the Breast by Use of One Large Field.** Andreas Frank. Strahlentherapie **89:** 533–537, 1953.

For the postoperative radiation therapy of carcinoma of the breast, the author uses one large field as suggested by G. Schwarz in 1935 (Strahlentherapie **53:** 674, 1935. Abst. in Radiology **25:** 643, 1935). With the arm elevated, the field is limited by the larynx, the sternal margin of the healthy breast, and the costal arch. Treatment is given at 80 to 100 kv., with 1 mm. aluminum filter. One series consists of 900 to 1,200 r given in six to eight treatments of 150 r each, spaced one day apart. Six series at five-week intervals bring the total dose to 5,400 to 7,200 r in about six months. These doses sometimes result in telangiectases.

Of 31 patients treated between 1945 and 1947 with this method, 21 or 68 per cent survived five years. Only 1 local recurrence was observed.

ULRICH K. HENSCHKE, M.D.
Columbus, Ohio

**A Method of Enhancing the Effectiveness of Radiotherapy in Cancer of the Uterine Cervix.** John Barkley Graham and Ruth M. Graham. Cancer **6:** 68–76, January 1953.

In considering the variable response of cervical carcinoma to radiation, the authors suggest that the patient, as well as the tumor, may be radioresistant. It was found that, when vaginal smears obtained immediately after irradiation showed radiation changes in less than 65 per cent of non-malignant cells, *i.e.*, a "poor response," the survival rate was significantly decreased. Only 2 of 63 patients survived five years as compared to 36 of 62 patients with a "good response" (more than 75 per cent of the cells showing a radiation effect).

In view of this observation, an attempt was made to increase the sensitivity to radiation. For this purpose, testosterone was administered to 4 patients and α-tocopherol to 1. A substantial rise in cell response was obtained following the use of these agents, but whether this will be reflected in an improved cure rate can be demonstrated only by treating a significant number of cases and following them for a prolonged period.

Of the authors' 5 patients, 2 are classed as failures; in 1 the result was inconclusive; 2 are "possibly better off than might have been expected."

The impression was gained that if there is not a pronounced reduction in the percentage of cornified cells during and after treatment the outlook is unfavorable.

Nine graphs; 1 table.

**Primary Carcinoma of the Vagina.** Irwin H. Kaiser. Cancer **5:** 1146–1160, November 1952.

Fifty-five women with histologically proved primary carcinoma of the vagina were seen at the University of Minnesota between 1927 and Dec. 31, 1950. In 49 cases the tumor was of the squamous-cell type; the other six tumors were adenocarcinomas. Every patient was followed until her death or until Dec. 31, 1951. At the time of the report 9 patients were alive and well. The absolute five-year-cure rate, based upon the 38 patients seen through 1946, is 13 per cent, and the relative five-year-cure rate, based upon patients treated, is 15 per cent.

Irradiation was the main form of therapy during the period of this study. In order to evaluate its effectiveness, the 41 patients who were given what is at present considered a suitable dose and distribution of radiation were grouped together and are referred to hereafter as the treated series. Two of these patients were subjected to surgical procedures in addition to irradiation. Three other patients did not complete the projected course of irradiation. All 5 cases are nevertheless included in the irradiation-treated series. The five-year-cure rate with irradiation is 11 per cent.

Twenty-seven patients were treated with x-rays and radium, 6 with x-rays and radon, 3 with x-rays alone, 2 with radium and radon, 1 with x-rays, radium, and radon, 1 with radium alone, and 1 with radon alone. The planned attack on the tumor has consisted of a course of deep roentgen therapy followed immediately by local applications of radium or radon. Roentgen therapy was omitted in only 4 patients, whose lesions were in such proximity to the vulva that the anticipated vulvitis was prohibitive. Roentgen therapy alone was employed only in those cases with such severe reaction early in the course of treatment that any further attempts at irradiation had to be abandoned.

The technic of deep x-ray therapy was in the process of development until 1938. From then until 1944, the physical factors employed were standardized for almost every case, as follows: 200 kv., with a half-value layer equal to 1.4 mm. of copper, at a focal skin distance of 60 to 70 cm. The main reliance was placed on anterior pelvic, right and left lateral pelvic, right and left posterior oblique, and right and left anterior oblique pelvic fields. The field size was 16 to 18 × 20 cm. for the anterior pelvic field and 12 to 14 × 18 cm. for all other fields. In most cases from one to three doses from a perineal portal were added. Treatment was administered over a period of twenty-five to thirty days. Daily doses of 300 to 400 r in air to one skin field were given six days a week. Equal air doses were administered to each field for a total depth dose of 3,000 tissue r to the center of the pelvis. In 1944, the technic was slightly modified. Since that time 400 kv. has been employed with a Thoraeus filter, giving a half-value layer of 3.9 mm. of copper with a focal skin distance equal to 70 to 80 cm. Usually the two anterior oblique fields have been omitted. The method has otherwise been unchanged, and the total depth dose has continued to be 3,000 tissue r in about twenty-eight days.

Application of radium and radon has been made with variations to fit the size and location of the lesion. For lesions restricted to the upper vagina near the cervix, a source consisting of an intracervical tandem of 15 mg. of radium element has been used together with an intravaginal source, usually of 15 mg., in a lead rubber carrier. For lower or more widespread lesions, radium

has been placed in dental wax molds that are shielded with lead if possible to reduce the dose given to uninvolved areas. The depth of the radium in the mold, the active length of the radium source, and its size have been determined by standard dose charts so as to produce at least 7,000 gamma roentgens to the furthest point at the depth of the tumor. Where the tumor has been too thick to allow this, the patients have been subsequently retreated if the lesion regressed sufficiently in size. Radium dosage has been standardized in respect to time so that all doses are calculated over a period of one hundred hours. When, as is the case with most patients in whom vaginal molds are used, the carrier must be removed from time to time, the one hundred hours includes only the time the carrier is actually in apposition to the tumor.

Radon, when used, has been administered in gold needles distributed around and in the depths of the tumor so as to produce comparable depth doses of radiation.

The incidence of fistulas on admission and after treatment was quite low. Other complications were irradiation ulcer (7 patients), vulvitis (6 patients), urinary tract infection (4 patients), severe leukopenia (2 patients), fracture of the femur (2 patients), reaction necessitating interruption of therapy (2 patients).

Death was attributable to the tumor in 39 of the 46 patients who have died. Although there was a 15 per cent loss of patients from other causes during the period of observation, 43 per cent of the patients in the total series and 29 per cent of the irradiated patients died without ever having had the primary tumor eradicated.

Seventeen tables.

**Beta-Radiation Therapy of Pterygium.** J. William Rosenthal. Arch. Ophth. **49**: 17–23, January 1953.

The study described here had three objectives: (1) to evaluate the usefulness of beta radiation from a radium applicator in the treatment of primary and recurrent pterygium, (2) to find an effectual and useful dosage schedule in this therapy, and (3) to compare the effectiveness of radium D with that of surgery alone and with that of combined surgery and x-irradiation in the treatment of primary and recurrent pterygium. Included in the investigation were 77 patients, with a total of 85 eyes with pterygium. Thirty-six patients (42 eyes) were treated surgically. Forty-one patients (43 eyes) were treated with beta irradiation. For all patients in the radium-D group, Swanberg's 10-mc. applicator was used.

The 10-mc. radium D applicator was found effective in the treatment of all types of pterygium. Such therapy obliterates the vessels and stops the growth of primary flat pterygia but usually leaves a scar (pterygium ghost) from the cornea to the conjunctiva, representing the former pterygium. The same is true of the primary meaty and vascular pterygia, but a scar always remains, possibly with some vascularity of the pterygium head. Recurrent flat or meaty pterygia react to treatment as do primary growths. Radium D therapy of pterygia often leaves considerable vascularity in the pterygium body despite cessation of growth and absence of vascularity in the pterygium head.

Pseudopterygium responds well to treatment with the radium D applicator. The results, however, depend upon the cause and pathologic anatomy.

In treating pterygia with the radium D applicator, more attention should be paid to the final total dose than to the manner in which the individual doses are applied, that is, the time per individual dose and the interval between them. Any convenient routine may be followed, one week being the minimum safe interval between doses. The total should be more for the meaty, vascular pterygia than for the flatter, more membranous type. The approximate total dose for the former should be 5-mc.-hr. and for the latter 2.5-mc.-hr.

Virtually no temporary or permanent harmful side-effects were produced by irradiation in this series of cases.

Judging from cell susceptibility, beta irradiation should be more effective if used early (during the first week) on a postoperative pterygium area to prevent recurrence than if used on a primary or fully recurred pterygium. Such therapy was not studied in the author's series.

The author believes that the McReynold transplantation plus early postoperative use of the radium D applicator is the best treatment for pterygia now available.

Two illustrations.

## RADIOISOTOPES

**Detection of Concealed Thyroid Disease by Tracer Technique.** L. Reynolds, K. E. Corrigan, and H. S. Hayden. J.A.M.A. **151**: 368–371, Jan. 31, 1953.

This paper summarizes five years experience with tracer technic in the detection of concealed thyroid disease (see also Corrigan and Hayden: Radiology **59**: 1, 1952). It is based upon the investigation of 2,046 problem cases. The technic involves careful uptake determinations over a period of thirty-two to fifty hours to ascertain (*a*) the anatomic localization of tissue metabolizing the isotope, (*b*) the rate of uptake and total uptake by tissue, (*c*) discontinuities and non-uniformities in masses found in the normal thyroid region or elsewhere, and (*d*) the rate of decrease in any localization showing an unusual falling off from its maximum concentration. In addition, urinary excretion is measured in individual samples (not pooled) and plotted against time.

The tracer technic is relatively simple, depending upon the use of a Geiger counter. It has proved useful in the demonstration of concealed toxic adenoma, as well as in the localization of retrosternal and postmediastinal toxic thyroids. It is particularly successful in the detection of thyroid carcinoma. For the latter purpose, the criteria to be sought are as follows: (1) rapid and abnormal rate of loss of the tracer from the malignant tissue; (2) continued loss of the tracer by urinary excretion after the excretion curve should have become asymptomatic; (3) if the tumor is large enough and has sufficient function, a return of the tracer to the liver, believed to represent an attempt at detoxification of some abnormal organic iodine compound; (4) localization of metastases. Using these criteria, the authors found 12 entirely unexpected cases of carcinoma, all verified by surgical and histologic examination. More commonly the procedure has been used to

verify or exclude a suspected carcinoma. Of 113 cases in which cancer was diagnosed, 109 were proved surgically or at autopsy. Of 256 cases in which the tracer indicated absence of a malignant lesion, only 1 proved to be a carcinoma. The net error for all procedures was 0.7 per cent.

In their conclusion the authors make the point that, to be of any real value, the procedure must be conducted in a well equipped, well staffed department of radiology, and that haphazard isotope procedures, depending on a single measurement of any sort and conducted by persons who, regardless of their other skills and attainments, are not specifically trained in this procedure, cannot be expected to yield results beneficial to the patient, the clinician, or the world of science in general.

Seven illustrations, including 1 roentgenogram.

DAVID D. ROSENFELD, M.D.
Fontana, Calif.

**Results of Treatment of Toxic Goiter with Radioactive Iodine.** Lindon Seed and Bertha Jaffé. J. Clin. Endocrinol. & Metab. **13:** 107–119, January 1953.

Two hundred and fifty-seven patients with hyperthyroidism treated with radioactive iodine at Grant Hospital, Chicago, were surveyed for their status six months to two years after treatment. This status was determined by the authors' personal examination in one-fourth of the number, and by contact (by telephone or letter) with the patients' referring physicians in the other instances. The results are considered to be representative of what may be expected at a clinical laboratory where patients are generally referred for radiotherapy only, with return to the referring physicians for aftercare.

A satisfactory remission was obtained in 64 per cent of the patients with exophthalmic goiter, in 68 per cent of those with recurrent exophthalmic goiter, and in 56 per cent of those with toxic nodular goiter. This gives an overall figure of 63 per cent returning to a euthyroid state, as compared with 80 per cent of 1,729 cases similarly treated, analyzed from a complete list of all follow-up studies reported in the literature up to April 1952.

Hypothyroidism occurred as a result of treatment in 14 per cent of the authors' series with exophthalmic goiter, in 10 per cent of patients with recurrent exophthalmic goiter, and in 4 per cent of those with toxic nodular goiter. The percentage of hypothyroidism occurring in the entire group is 11, as compared with 9 per cent in the large series compiled from the literature.

In 25 per cent of the authors' patients the results were considered to be unsatisfactory. The comparable figure for the collected series is 11 per cent.

The authors consider that surgery is the treatment of choice in toxic nodular goiter and in diffuse toxic goiters which are very large. Otherwise radioiodine is the treatment of choice for toxic goiters. Complications in their series were few, and none were serious. The average patient with a diffuse toxic goiter is given 6 to 8 millicuries as an initial dose, or more for larger goiters. With toxic nodular goiters the initial dose must be 20 or 35 millicuries, and it is very likely that repeated doses at intervals of two months will be necessary.

Four tables.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

**Graves' Disease: Hyperthyroidism or Hyperpituitarism?** Sidney C. Werner, Howard Hamilton, and Martha Nemeth. J. Clin. Endocrinol. & Metab. **12:** 1561–1571, December 1952.

The authors present data obtained by experimental administration of thyrotropin and thyroid to patients with active otherwise untreated Graves' disease and to patients recently brought into a state of remission with $I^{131}$. These suggest that hyperthyroidism arises from mechanisms not mediated through the anterior pituitary.

In active Graves' disease thyrotropin produced an increased release of hormone from the thyroid as judged by an increase in the serum precipitable iodine level. Thyroid did not depress the hyperthyroid gland as judged by the twenty-four hour uptake of radioiodine.

In $I^{131}$-treated Graves' disease thyrotropin produced a slight rise in the level of serum precipitable iodine. Thyroid by mouth decreased the twenty-four hour uptake of $I^{131}$.

Seven figures; 2 tables.

PAUL MASSIK, M.D.
Quincy, Mass.

**Normal Birth of a Healthy Girl after Successful Treatment of a Metastasizing Malignant Goiter by Means of Radioactive Iodine** ($I^{131}$). J. H. Müller and C. Brunner. Schweiz. med. Wchnschr. **83:** 54–55, Jan. 17, 1953. (In German)

A 22-year-old woman underwent thyroidectomy in August 1947 for papillary adenocarcinoma of the thyroid. At the time of the operation metastases were already found in several lymph nodes of the neck. Operation was followed by intensive x-ray irradiation with a dose of 5,400 r. About a year later a second operation was necessary for a recurrence in the right neck. An extensive tumor reaching deeply into the mediastinum, unsuitable for radical removal, was found. In spite of the hopeless prognosis, the patient married in the autumn of the same year. Treatment with radioactive iodine was begun in January 1949, and a total of 95 millicuries of $I^{131}$ was administered orally in the course of several months. Due to the destruction of the remaining thyroid tissue by radioactive iodine, myxedema ensued, but was controlled with thyroid medication (Thyrakin). Three and a half years after application of radioactive iodine there is complete freedom from symptoms; "the healing test" shows an effective elimination not only of the thyroid tissue but also of the carcinoma metastases.

About three years after treatment the patient gave birth to a healthy girl weighing 3,400 gm., with no evidence of abnormality or malformation. The puerperium was entirely normal, and the patient nursed the child without difficulty.

Two illustrations.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

**The Effect of Thiouracil on the Collection of Radioactive Iodine in Experimentally Induced Thyroid Tumors.** William L. Money, Patrick J. Fitzgerald, John T. Godwin, and Rulon W. Rawson. Cancer **6:** 111–120, January 1953.

Young adult rats which had received Thiouracil in the drinking water for various periods were given 5 microcuries of carrier-free $I^{131}$ intraperitoneally and autopsied twenty-four hours later. A definite trend toward a higher incidence of thyroid tumors was seen following prolonged treatment with Thiouracil

The absolute amount of radioactivity concentrated per unit weight of thyroid was found to be relatively low in animals receiving Thiouracil for prolonged periods. It is to be borne in mind, however, that a major portion of the total gland may not concentrate any radioiodine. Therefore, the $I^{131}$ present, and probably organically bound, may be localized in a small portion of the total gland. Under such conditions, the relative concentration of $I^{131}$ localized in a particular area may be very high.

The presence of $I^{131}$ in the thyroid tumors and in abnormal follicles, as demonstrated autoradiographically, strongly suggests that these tissues have escaped the normal block imposed by Thiouracil. Three possible explanations are offered: First, it may be that the dose necessary to block such areas differs greatly from that which inhibits normal thyroid. Second, the Thiouracil may not penetrate into the cells of these abnormal areas, though this seems unlikely. Third, some chemical compound that is normally inhibited by Thiouracil may be lacking in these abnormal tissues.

Sixteen illustrations.

**Factors Governing the Development of the Chick Embryo. I. Determination of the Time at Which $I^{131}$ Collection Begins.** J. B. Trunnell and F. T. Brayer. J. Clin. Endocrinol. & Metab. **13:** 88–94, January 1953.

Radioactive iodine was injected into chick embryos in order to ascertain the stage of development at which the thyroid gland first begins to concentrate iodine. It was found that injections into the chorio-allantoic membranes produced more uniform concentrations in the thyroids than did injections into the yolk sacs, and larger concentrations than injections into the air chambers. It was determined that selective concentration of $I^{131}$ commenced toward the end of the tenth day of incubation.

A parallel series of injections of $I^{131}$ were made on embryos into whose chorio-allantoic membranes thyrotropic hormone had been introduced forty-eight hours earlier. The thyroids of these embryos did not collect iodine any sooner than those of the uninjected controls, but did collect somewhat greater quantities.

Three tables. ARTHUR S. TUCKER, M.D.
Cleveland Clinic

**Effect of Prolonged Administration of Radioactive $Zinc^{65}$ on the Pancreas.** James W. Sherrill and Arne N. Wick. J. Lab. & Clin. Med. **41:** 40–42, January 1953.

Because of the close association of zinc, insulin, and the pancreas, the prolonged administration of radioactive zinc, a strong beta emitter, might be expected to result in the destruction of the insulin-producing cells of the pancreas. The authors tested this hypothesis by administering $Zn^{65}$ to rats over a period of six months. No diabetic symptoms, such as loss of body weight, glycosuria, or high blood sugar, were produced in these animals.

One graph; 1 table.

## RADIATION EFFECTS

**A Histochemical Study of Irradiated Bone.** M. S. Burstone. Am. J. Path. **28:** 1133–1141, November-December 1952.

Continuous irradiation of developing bone from assimilated radioactive material has been found to result in an abnormal reparative process during which there occurs an accentuation of the process of bone formation as well as resorption. Following internal administration of beta emitters ($P^{32}$ or $Sr^{90}$), bone exhibits certain characteristic changes. These include replacement of hematopoietic cells by "gelatinous" marrow containing abnormal reticular cells. Subsequently, atypical bone develops in the marrow, especially near the damaged epiphyseal cartilage. Large numbers of osteoclasts may be seen adjacent to these spicules of bone.

In an attempt to elucidate the pathogenesis of irradiation changes as suggested by previous work, certain histochemical methods were employed in order to study the bone matrix and related intracellular precursors. Specifically, the periodic acid-Schiff method developed by Hotchkiss and others for demonstration of carbohydrates and glycoproteins was utilized. This made possible a study of carbohydrate-protein complexes in the bone matrix as well as within cells.

Ten C57 mice, one to three days old, were injected subcutaneously with a carrier-free solution containing $P^{32}$, as sodium phosphate, in a dosage of approximately 20 μc. per gm. of body weight. Controls consisted of uninjected immature mice of the same age as well as mice injected with non-radioactive phosphate solution. Another series of 8 three-day old mice were injected adjacent to the knee joint with a suspension of chromic phosphate containing $P^{32}$ (activity, 10 microcuries per c.c. of suspension). The opposite knee joint was studied as a control. Other controls for this series were injected in the same area with a non-radioactive suspension of chromic phosphate. All animals were sacrificed seven days following injection.

The administration of $P^{32}$ resulted in a destruction of normal marrow and its replacement by abnormal connective tissue (reticular) cells. These cells were characterized by increased amounts of glycogen, glycoprotein, alkaline phosphatase, and phosphate-carbonate presumably present as calcium salt. They were associated with an amorphous glycoprotein matrix, which may become calcified to form immature bone.

It is believed that under normal as well as pathologic conditions, cells of connective-tissue origin, including osteoblasts, elaborate the glycoprotein ground substance or its precursor. However, the glycoprotein matrix laid down following irradiation is conspicuously different from normal matrix seen in animals of comparable age. It is postulated that this matrix represents glycoprotein in a lower state of aggregation or polymerization than normal. The work of Cobb (Master's thesis, Graduate School, University of Illinois, 1949) and Heller-Steinberg (Am. J. Anat. **89:** 347, 1951) indicated that such a state of the matrix favors calcification, a transformation agreeing with the present author's findings.

Six photomicrographs.

**Histochemical Studies on the Lens Following Radiation Injury.** Solbert Permutt and Frank B. Johnson. Arch. Path. **55:** 20–30, January 1953.

Many complex organic compounds have been shown to fragment or split when exposed to various types of

irradiation *in vitro*. It was felt, therefore, that some of the *in vivo* effects of irradiation might ultimately be explained in terms of depolymerization of certain constituents of tissues. The authors' studies have been carried out with special emphasis on the polysaccharide-protein components of the lens.

The normal lens was studied in adult male rabbits, Sprague-Dawley rats, and white mice. The effects of x-rays and slow neutron irradiation were studied only in rabbits. One rabbit was three years old at the time of irradiation and received 1,500 r of 1.2 mev energy to the right eye 230 days before study. Another was ten weeks old at the time of irradiation and received 1,500 r of 1.2 mev energy to the right eye 160 days before study. Six 10-week-old rabbits were exposed to slow-neutron fluxes varying from $2.08 \times 10^{10}$ n/cm.$^2$ to $2.41 \times 10^{11}$ n/cm.$^2$ and were killed approximately 250 days later.

Polysaccharide-protein complexes were demonstrated in the capsule, cement substance, epithelial cells, and fibers of the normal lens. Three definite changes occurred in these structures as a result of exposure to irradiation: (1) There was marked swelling of the capsule, the fibers, and the cement substance. In the fibers, the swelling was accompanied by an increase in fluid content. (2) There was an increased reaction with the Hotchkiss stain, especially marked in the large lenticular fibers but also present in the capsule and cement substance. (3) There was an increased solubility of the carbohydrate-protein complexes, especially in the capsule and cement substance. These changes are attributed to depolymerization of the polysaccharide-protein complexes of the lens. The damage to the lenses caused by slow neutron irradiation was much more marked than the damage caused by x-rays.

The relation between the depolymerization and the pathogenesis of radiation cataracts is discussed.

Four photomicrographs; 3 tables.

**Hydropericardium Following X-Ray Irradiation.** F. Wachtler. Radiol. clin. **22**: 1–9, January 1953. (In German)

During x-ray treatments of intrathoracic cancer or tumors of the thoracic wall, healthy lung tissue and the heart usually receive a considerable amount of radiation. Changes in the lungs, including induration, fibrosis, and pneumonitis have been reported. Irradiation damage to the heart muscle and pericardium is less common, as their tolerance is extremely high.

The author describes two cases of carcinoma of the breast in which intrapulmonary changes and hydropericardium were observed, following roentgen irradiation to the left side of the thorax after radical surgery. The irradiation changes in the lungs were located in the left infraclavicular area and left upper pulmonary field, where the portals easily override. The author believes that a fractionated dosage of at least 2,000 r at the thoracic wall is necessary to produce irradiation changes in the lungs. In extremely rare instances, when a higher dosage is given, hydropericardium may occur. As the lung tissue is more radiosensitive than the myocardium and pericardium, pulmonary irradiation damage must be present if, in the same case, a hydropericardium is to be attributed to irradiation.

In both the cases reported here a causal connection with the x-ray treatments could be assumed, since the heart was in the x-ray beam and the radiation was adequate qualitatively and quantitatively. The interval between irradiation and the onset of the effusion was also suggestive.

A diseased heart muscle seems to be a contributing factor in pericardial effusion after x-ray irradiation, just as irradiation fibrosis in the lungs is more apt to occur in the presence of a pre-existing infection or other pulmonary disease.

Four roentgenograms.

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**Nuclear Changes in Response to Continuous Irradiation.** M. S. Burstone. Arch. Path. **55**: 55–62, January 1953.

Exposure of epithelial surfaces to ionizing irradiation from x-ray sources as well as from radioactive isotopes has long been known to result in formation of enlarged hyperchromatic nuclei. These nuclei may be lobulated and contain discrete aggregates (chromatin) which stain intensely with routine histological stains. Underlying these changes in nuclear morphology and staining qualities may be alterations in the chemical and physical characteristics of the nucleoprotein. In the work discussed here, nuclear aberrations produced by continuous irradiation from radioactive phosphorus were studied by means of histochemical procedures for the visualization of desoxyribonucleic acid. These methods were used in conjunction with fixation by freezing and drying.

Fifteen young adult C57 mice were injected in the tongue with approximately 0.02 c.c. of a suspension of radioactive chromic phosphate containing $P^{32}$ (activity 800 $\mu$c. per cubic centimeter). As controls some animals were untreated and others were given injections of non-radioactive chromic phosphate in the tongue.

The continuous irradiation of moderate intensity from the locally injected suspension containing radioactive phosphorus resulted in striking nuclear changes in the tongue. Greatly enlarged nuclei of the irradiated epithelium exhibited clumps of chromatin which stained with the Feulgen procedure. Treatment of tissue sections with desoxyribonuclease resulted in a marked diminution in stainability of irradiated nuclei as contrasted with normal nuclei. Preliminary work indicates that irradiation of the intensity employed will not produce extensive necrosis of tissue and that the epithelium of the tongue will appear relatively normal within a month.

It is postulated that continuous irradiation results in the formation of nucleic acid complexes in a less aggregated state than normal.

Six photomicrographs.

**The Effect of X-Radiation on the Oxygen Uptake of Embryonate Eggs.** Donald Greiff, Herman T. Blumenthal, Masahiro Chiga, and Henry Pinkerton. J. Exper. Med. **97**: 131–134, Jan. 1, 1953.

**The Effect of X-Radiation on the Multiplication of Influenza A Virus in Embryonate Eggs.** Herman T. Blumenthal, Donald Greiff, Masahiro Chiga, and Henry Pinkerton. Ibid. 135–137.

**The Effect of X-Radiation on the Multiplication of Rickettsia mooseri in Embryonate Eggs.** Donald Greiff, Masahiro Chiga, Herman T. Blumenthal, and Henry Pinkerton. Ibid. 139–144.

Previous studies on the effect of x-radiation on the oxygen uptake of living organisms have given varied

results. Embryonate eggs offer certain advantages for the study of this problem. They can be maintained at constant temperatures, and their convenience makes it possible to obtain data at frequent intervals on groups large enough to average out individual differences. The investigations reported in the papers under consideration were made not only for their intrinsic interest, but also to correlate the effects of radiation on the growth of rickettsiae and viruses in embryonate eggs.

The first study comprised three experiments in which groups of 10-day-old embryonate eggs were given 250, 500, 750, and 1,000 r of x-radiation, and oxygen consumption determinations were made subsequently at various intervals during a period of ninety hours. In general, the effect of radiation was moderately stimulatory, but after ninety hours the respiratory rates of the 250 and 1,000 r groups were well below those of the control groups. The most striking effect, noted in the 3 separate experiments, was the occurrence of a "3-step staircase" type of oxygen consumption curve in all irradiated groups, the leveling off periods apparently occurring between the 4th and 14th, the 24th and 36th, and the 42nd and 66th hours after exposure. These curves were in striking contrast to those shown by groups of non-irradiated eggs, which were practically of the straight line type.

The purpose of the second study was to determine whether the metabolic alterations caused by x-radiation would influence the growth of influenza A virus in fertile eggs. Groups of embryonate eggs were given 250, 500, 750, and 1,000 r of x-radiation. Eighteen hours later, these 4 groups, together with a control group, were injected intra-allantoically with influenza A virus. Radiation at all dosage levels caused significant changes in the infectivity titer curves during the next ninety hours. The most striking alterations were a prolonged incubation period and uniformly low infectivity titer in the group of eggs given 750 r.

The third study had to do with the effect of radiation on the host-parasite relationship in experimental rickettsial infection. It was found that the multiplication of *Rickettsia mooseri* in fertile eggs is speeded up and quantitatively increased by single dose x-irradiation given either twenty-four hours before or forty-eight hours after inoculation. This effect was noted at all dosage levels studied, ranging from 100 to 1,500 r. The rickettsiostatic effects of high incubation temperature (40° C.) and of Streptomycin are neutralized by radiation, but the rickettsiostatic actions of PABA, Penicillin, and Aureomycin are not altered. Possible mechanisms of action and implications of the observed effects are discussed.

Two graphs; 4 tables.

**An Unfavorable Reaction to the Use of Streptokinase-Streptodornase in Indolent Postroentgen Irradiation Ulceration.** S. Gordon Castigliano and C. Jules Rominger. Am. J. Surg. **85**: 55–61, January 1953.

Two cases of post-irradiation ulcer of the breast are reported in which streptokinase-streptodornase solution was applied as a forty-eight-hour wet dressing on six occasions over a seven-day period in the first case and a twenty-day period in the second case. An outpouring of fluid and debris, a febrile reaction, and a remarkably rapid increase in the depth and width of the ulcers followed. In each case resection of exposed rib became necessary. The rapid breakdown took place during the period of streptokinase-streptodornase therapy. The size of the ulcers became stationary when the use of the enzymes was discontinued. Healing of the ulcers did not begin until treatment with activated zinc peroxide paste and radon ointment was started.

Following irradiation, many cells are in a marginal state of viability because of impaired blood supply and vitality. A number of these cells which form the base and edges of an indolent ulcer would survive and contribute to repair if they received ideal supportive treatment. Streptokinase and streptodornase are believed to destroy and digest these marginal cells. The authors have therefore discontinued the use of these enzymes in the treatment of post-irradiation ulceration in areas such as the chest, lateral neck, axilla and groin, where perforation may develop or where large vessels are contained in the tissue bed.

Three illustrations. RICHARD F. MCCLURE, M.D.
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ERRATUM

Attention is called to a serious error appearing in a paper by Clark *et al.* on "Five Year Experience with Radioactive Iodine in the Treatment of Hyperthyroidism" published originally in the *J.A.M.A.* and abstracted in RADIOLOGY (**61**: 466–467, September 1953). Unfortunately the error in the original paper was repeated in the abstract, and for that reason attention is called to it here. In the fourteenth line in the first column of page 467 (of RADIOLOGY) the initial dose of radioactive iodine should be given as "150 or 250 μc. (or 0.15 or 0.25 mc.) per estimated gram" instead of "150 or 250 mc.," and a corresponding change should be made in the sixteenth line "300 to 350 μc." instead of "300 to 350 mc."

While the radiotherapist would undoubtedly recognize the figures as erroneous, it is not amiss to call attention here to the importance of distinguishing between these two units of dosage so easily confused in the printed text.

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